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An Expensive Dispute

THE futility of some of the controversies arising under the A.R.A. Rules of Interchange, in which the cost of carrying the cases through to a final settlement by the Arbitration Committee may be out of proportion to the financial value of the decision, has frequently been commented on in discussions of the application of the Rules of Interchange. There are also certain cases where the per diem rules are involved in which, unless the case is a strong one, the value of a favorable decision under the interchange rules, even though in itself well worth while, is not sufficient to justify the risk of incurring the cost of per diem during the period involved in the settlement, should the case be lost.

Such a situation developed in a controversy on which a second decision was rendered by the Arbitration Committee last year, involving a car originally reported to the owner for disposition under Rule 120. The owner contended that the car should have been reported under Rule 112, and nineteen months after the occurrence of the damage leading to the controversy the Arbitration Committee decided in favor of the owner. Following that decision, the handling line destroyed the car and so reported to the owner. A second controversy then arose in which one of the points at issue was whether or not the depreciated reproduction value of the car should be figured as of the date on which the damage occurred, or the date on which the car was regularly reported as destroyed by the handling line under Rule 112. The Arbitration Committee decided this point in favor of the later date.

Under Rule 7 of the code of per diem rules, it would seem that the car should continue to earn per diem for the owner until this later date, at a cost to the handling line of well toward $600 for the period following the date of the original damage. The gross cost to the handling line of the settlement under Rule 112 (before deducting salvage) was approximately $300 as the case was finally decided, and would probably have been less than $400 had the car been immediately reported under Rule 112. To effect a possible saving of less than $400, therefore, the handling line incurred the risk of a settlement which, as the two cases were finally settled, involved a total cost close to $900.

It is not the purpose of this discussion to enter into the merits of the original controversy with respect to the application of Interchange Rules 120 or 112, but merely to point out the fact that the tremendous increase in the cost when the handling line loses such a case should deter it from an attempt to shift the responsibility to the car owner if its case leans heavily on technicalities or evasions of the conditions clearly defined under Rule 32. The Arbitration Committee has a consistent record of adherence to the letter of the latter rule which, indeed, is the only course open to it if the spirit of the rules as a whole is to be maintained and applied in an orderly manner.

Motorize Wood Mill Tools and Save Money

THE majority of railway planing mills in service today were built when wooden cars were more prevalent than they are now. Although steel is gradually supplanting wood in car construction, all railroads are operating one or more planing mills, depending on the amount of wood work to be done, and must continue to do so indefinitely. In most cases, little or no effort has been made to modernize the planing mill with the objective of reducing shop operating costs. The question will naturally arise: "How can a woodworking shop be modernized without purchasing modern machines?" The answer is: "Motorize the machines now in use." Such a program is now being carried out in a large planing mill of an eastern road. At the present time, all of the machines in this shop are belt driven from overhead shafting, which requires about 1,000 hp. to operate all of the machines at one time. The line shafting is now being removed and all of the machines will be driven by individual motors. When the installation is completed, it will require about 475 hp. to drive the same number of machines, thus effecting a saving of 525 hp. The railroads pay from one cent to two cents per killowatt-hour for power. Thus, taking a round figure of 500 hp. per hour as the amount of power saved by the changeover, the railroad will save from five to ten dollars an hour, or from $40 to $80 a day, figuring on the basis of an eight-hour working day. By carrying the calculation still further, an approximate saving of $15,000 a year will be effected, considering that the shop works only five days a week, This is a substantial saving which justifies the expenditure involved in motorizing each machine. Of course, there are other advantages to be gained, such as the elimination of the possibility of having to shut down a group of machines while repairs are being made to the shafting from which they are driven; not having to drive the shaft for a group of machines in order to operate only one, which factor is important in a wood-

mill where all machines are not run all of the time; each machine will be furnished with its maximum horsepower when required, which is not always the case when driven from a line shaft. Individual motor drive for planing-mill machines offers a splendid opportunity to effect a real economy in more ways than one.

A One-Coat Varnish Job

AN artist can see many defects in a painting that would never be discovered by the average person. The artist, because he is an expert and takes a peculiar pride in his work, will go to extremes in painstaking care and expense in order to produce a painting that will please the most severe critic. This attitude toward one's own work serves to illustrate the viewpoint of many master painters toward the decoration and finish of passenger-car interiors. The foreman in the coach paint shop dislikes to have a coach leave his shop that does not represent the best his men can produce in excellence of workmanship and perfection of finish. His is the one department in the shop that has a real opportunity to display the results of its handiwork to the public. He insists on having good materials to work with, and he usually gets them. It can also be said that the majority of railroad master painters use their materials economically.

However, because he is something of an artist, he is more likely than not to be overly critical of the work that goes out of his shop. For example, he may apply an extra coat of varnish to the interior in order to secure a quality of finish that in his judgment is necessary to secure the desired perfection in the appearance of the coach as it leaves the shop. Then, when the coach comes into the shop eight or ten months later for repairs, he will have the interior washed down and another coat of varnish applied. This operation may be repeated for several years until there are six or seven coats of finish on the inside walls of the car, and the thickness of the paint has become noticeable, even to those who are not painting experts.

This raises the question whether the railroad desires the coach to present its best appearance immediately after repairs or a more uniformly good appearance during the several years before complete refinishing becomes desirable. One road in the south has, for a number of years, been following the practice of applying only one coat of interior varnish on one coat of paste filler, and two coats of shellac after the old paint has been burnt off, and then applying a coat of varnish after each rewashing. It must be admitted that these cars present a very good appearance to the untrained eye when they first leave the shop, and they continue to present a good appearance after they have been in service for several years. The saving effected by applying only one coat of varnish and then building up with additional coats each time the car comes into the shop for light repairs, is considerable.

The *Railway Mechanical Engineer* is not advocating a decline in the quality of the finish that is being produced by the coach paint shops of American railroads, but merely raises the question whether it is not possible to improve the general average of interior appearance and at the same time effect a real economy. The columns of this magazine are open for discussion of this subject Is the master painter spending too much time and money to secure a quality of finish that will please the expert when fresh, rather than doing a job that will give a more enduring pleasure to the traveling public?

Possibilities of Material-Handling Equipment

THE automotive industry was first among the great industries of this country to appreciate fully the savings that could be effected in manufacturing costs by the intense utilization of material-handling equipment. As this industry sells its product in a highly competitive market, it must take full advantage of every mechanical device that will help to reduce production costs.

During this period of intensive development in other industries, the railroads were somewhat slow in adapting all types of modern material-handling equipment for use in railway shops. As the primary function of the railroads is to sell transportation and not a product in a highly competitive market, they did not have the same incentive as the automotive industry. It has only been since the war that the railroads have concentrated on improving the quality of maintenance and at the same time reducing the costs by every means which they could find.

During the past few years, the railroads have not only purchased large quantities of material-handling equipment, such as cranes, hoists of all types, and power trucks, but have effected large economies by their use. Although innumerable examples could be cited to substantiate the claim that the judicious use of such equipment effects substantial economies, only a few will be cited to show what results have been obtained.

At one large railroad repair shop at which approximately one hundred locomotives received class repairs each month, the driving-box repairs are made in a separate department. Until a few years ago, hand trucks and laborers were used to move the driving boxes from one operation to the other. The foreman of this shop visited an automobile manufacturing plant in which he saw the monorail-hoist system used to carry parts from one machine to another. He applied the same principle in his department with the result that he entirely eliminated the use of hand trucks and effected a yearly saving of $6,000.

In these same shops, many new machine tools were installed. They were so grouped that instead of having one hoist for each machine, a 15-ft. swinging arm on which an electric hoist was mounted, is used to serve three or more machines, depending on their size.

Many railroads within the past few years, have taken full advantage of the operation of power-operated trucks for the handling of material. They have eliminated the use of hand trucks for hauling locomotive parts from the erecting floor to the machine shops and back again.

Hand trucks are now seldom used to haul material from the stores department to the repair shop. One railroad has effected an annual saving of $15,000 in its car department by the substitution of a truck-trailer system for hand trucks.

The substitution of tractors for the shop-shifting crew has paid handsome dividends to several railroads. One railroad has effected an annual saving of $23,000 by using one tractor in place of the passenger-shop shifting crew. The tractor places the cars in the repair shop, moves them over to the paint shop and places the finished cars on the shop track for the night-shifting crew to take away. As the shifting movements are not

sufficient to keep the tractor busy during its tour of duty, it is used for general service about the shop.

Several railroads have put a fleet of shop trucks in service without giving adequate consideration to the roads over which they were to operate. As a result, the anticipated economies were not obtained because poor roads slowed up the movement of the trucks and increased their maintenance because of hard usage over rough roads. One railroad that has been using many power trucks has fully realized the importance of hard-surfaced roads and has appropriated $100,000 for the building of roads throughout the shop layout during 1929.

Although there are many railroads that are using material-handling equipment to advantage, there are still many railroads, both large and small, that are still using the time-worn material-handling facilities. These railroads could reduce equipment-maintenance expenses considerably by the intensive utilization of modern material-handling equipment.

Keeping an Open Mind

THE striking improvements in general railway operation, as well as locomotive and car construction, especially in the past decade, are ample proof that railroad men in general entertain a favorable attitude towards new ideas of merit. This does not always hold true, particularly with regard to European developments, such as the turbine locomotive, for example, and many American motive power officers feel that, owing to great differences in practice, they need give little, if any, consideration to what European roads are doing. Is this attitude justified or wise in the interests of economy and in the light of past experience?

The value of looking outside of our own borders to Europe for improvements in practice is illustrated in the development of turbo-generators for power plants. On November 14, 1928, the Commonwealth Edison Company celebrated with fitting ceremonies, including speeches and the unveiling of a handsome bronze tablet, the twenty-fifth anniversary of the opening of the mammoth Fisk street (Chicago) power station, the first turbine-equipped plant of its kind in America. When this station was constructed in 1903, steam turbines were an unknown quantity in this country and all that the designers had to go by was certain studies of turbine installations in Europe. The possible economies of the steam turbine were highly attractive but it represented an innovation in American practice which no one could be sure would be successful. As the principal speaker at the Commonwealth exercises, Samuel Insull, president of the Commonwealth Edison Company, said:

"The question was, what we should do; whether we should start ahead and bore with a big auger, or whether we should, so to speak, go on living from hand to mouth and maybe add a turbine to a reciprocating-engine station and put off the day when we would build a large turbine station.

"Mr. Coffin, the president of the General Electric Company, a man of probably the greatest vision of any man who has ever been engaged in the electrical business, was not particularly anxious to build a 5,000-h.p. unit or a 5,000-kw. unit. He did not want to take the risk. His engineers were not anxious for it. Finally, we settled it this way: I said, 'I will take all the risk of the machine running successfully; that is, I will make no claim against you if it is not successful. All you have to do is to take the apparatus out and throw it in the junk pile. We will be at the expense of a turbine station which we may have to remodel considerably to turn it into a reciprocating engine station. We will take that end of the risk. You take the manufacturing end of the risk.' And that was the character of the contract we made.

"The first turbine was not economical. I think it was the fourth turbine we installed here, which is about like these present turbines, that was a really efficient turbine. We threw away the first three; that is, we threw away about 20,000 kilowatts before we got a really economical turbine.

"I think this station marks the modern development of the production of electrical energy from steam and its distribution over large areas, such as we are used to having. I believe the Fisk street station as long as it exists will be a monument to that departure."

When the Fisk street station was started in 1903, the maximum power load in the Chicago district was 34,000 kilowatts, which has increased in the 25 intervening years to 1,216,000 kilowatts. What it would mean to attempt to furnish this power with reciprocating-engine plants can be readily imagined. The pioneering in turbo-generator construction, coincident with the development of the Fisk-street power station, was more or less inspired by early European experiments. It revolutionized central station practice in America and was a substantial contribution to progress in many lines of industrial endeavor.

It is not the province of the *Railway Mechanical Engineer* to say that the steam-turbine locomotive is adaptable to railroad operating conditions in this country. The fact remains, however, that it is being extensively tested in Europe and South America and evidently possesses certain features of merit. Clearly it is a development which, along with numerous others, American locomotive designers cannot afford to dismiss without consideration, simply because operating conditions in this country and Europe are different.

New Books

RECORD AND INDEX. *Published by the American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York. 300 pages, 6 in. by 9 in. Board binding.*

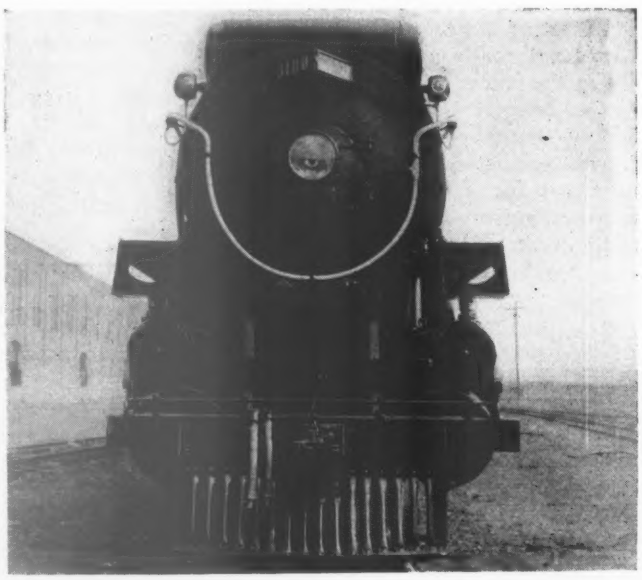
This is volume No. 1 of a book in the new publications program of the American Society of Mechanical Engineers, the purpose of which is to record for reference the varied activities of the society as a whole and those of its many units. Heretofore some of this material has appeared in the Year Book and some in Transactions. Under the new policy, the Year Book is replaced by the Membership List which contains only the alphabetical and geographical lists of members, and the personnel of committees. The technical papers appear in Transactions, each section of which contains a group of papers sponsored by one of the Professional Divisions of the Society and bears the imprint of that division. Record and Index, therefore, contains historical and reference material heretofore published in the Year Book and Transactions, also an entirely new section—an index to papers and reports presented before the Society at its meetings during 1927 and published or scheduled for publication, and all codes and standards published by the society during 1927.

Two 4-8-4 Type Locomotives Built by Canadian Pacific

Dome shut-off valve, drawbar and arch tube sleeves are of unusual design—Alloy steel extensively used

TWO experimental locomotives, designated as the K-1 class and numbered 3100 and 3101, have recently been put into service by the Canadian Pacific. The maximum tractive force of 60,800 lb. for these locomotives, which were designed by the railroad company's mechanical department and constructed at the Canadian Pacific's Angus shops in Montreal, Que., makes them, as far as is known, the heaviest and most powerful passenger locomotives in use in the British Empire.

The standard passenger locomotive now in operation on Canadian Pacific lines is a Pacific type locomotive of 45,000 lb. tractive force and this, in its present or modified form, is of ample capacity for general service. For the heavier passenger trains with severe schedules and for heavier grade work, the need is being felt for more powerful locomotives and the K-1 class has been designed to supplement the standard Pacific type locomotive for grade work or on heavier trains coupled with severe schedules. At present, the two engines are operating east of Toronto to Smith Falls, a distance of 212 miles, or covering two divisions.



A front view of one of the new Canadian Pacific locomotives

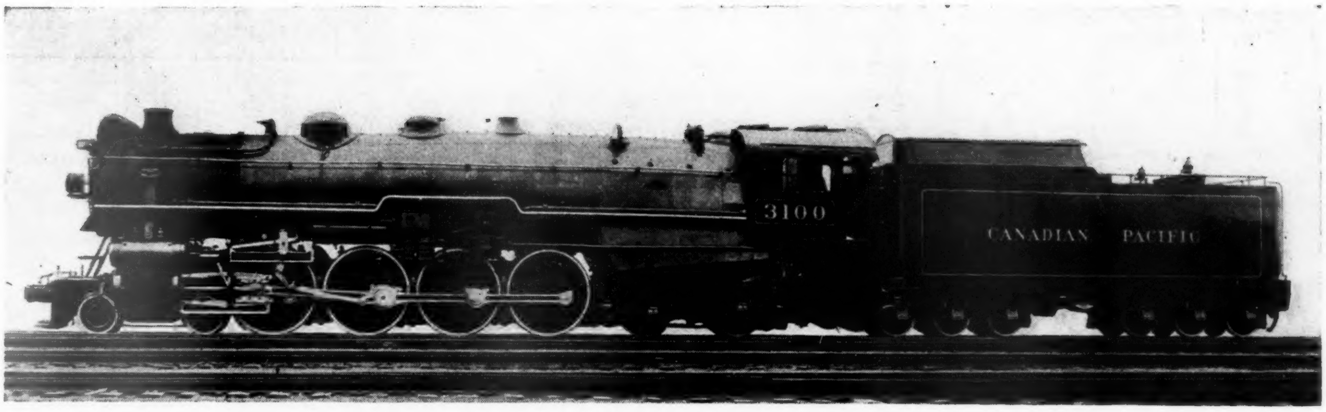
The locomotives operate at 275 lb. boiler pressure, which not only improves the economy, but gives a smarter locomotive with better acceleration. The high pressure enables the reduction of the cylinder diameter to 25½ in., the stroke being 30 in. The driving wheels are 75 in. outside diameter; the weight on drivers, 250,000 lb., and the total engine weight 423,000 lb. The maximum tractive force of these locomotives—60,800 lbs.—is based on 85 per cent of the boiler pressure as provided for in the customary maximum tractive-force formula. It is pointed out, however, that with the continued increase in boiler pressures and improvements in efficiency and capacity of boilers this formula is really misleading and a more consistent formula would provide for a varying factor with the use of increased pressures.

The boiler has probably utilized more nickel-alloy steel than any other locomotive boiler yet constructed. The shell plates, fire box sheets, tube sheets, staybolts, arch tubes and arch tube ferrules are all of nickel steel. All other parts including flues, tubes, rivets, braces, etc., are of carbon steel, no wrought iron being used in the construction of these locomotives in any detail. The use of nickel steel in firebox and tube sheets was resorted to not only to increase the factor of safety with the higher boiler pressure, but also to assist in resisting the expansion and contraction stresses, particularly in the radius of the tube sheet and in the side and throat sheets. The barrel course sheets and welt plates are the railway company's standard nickel steel which has been used not only for greater toughness desirable with the increased boiler pressure but on acount of the 28 per cent saving in boiler weight realized by the use of alloy steel instead of carbon steel. The boiler is of conical construction and has an outside diameter of 84¼ in. and an outside diameter of the third course of 96 in. The length over tube sheets is 20 ft. 6 in., with a 5-ft. combustion chamber. The total combined heating surface is 7,043 sq. ft. which, with 93.5 sq. ft. of grate area, provides 1 ft. of grate area for every 75.2 sq. ft. of combined heating surface.

A type E superheater is used with 28 double and six single units. The Elesco feed-water heater is also used for boiler feed.

In order to reduce the size of holes into the boiler a separate manhole 17 in. in diameter, has been placed directly back of the main dome. The safety valves are screwed into the manhole cover and a lifting ring is provided so that the entire ring and cover with safety valves can be removed for access to the boiler for examination purposes.

The main steam dome is only large enough to provide proper space and cross-sectional area for the stand pipe. This arrangement has permitted keeping the hole in the boiler down to a size of 17 in. by 20 in. A shut-off valve of a new design is attached to the under side



One of the two 4-8-4 type locomotives built at the Canadian Pacific Angus shops, Montreal, Que.

of the main steam dome cover, the valve itself seating on top of the stand pipe. The valve is of flat plate type and is suspended by a toggle arrangement from the under side of the dome cover. This toggle arrangement is operated by a lateral screw running across the under side of the dome cover and operated by a hand crank from the outside. This design does away with any extensions above the top of the dome, giving a maximum dome height above the water level. A pilot valve is also provided with a lift of ⅜ in. which opens before the main plate valve. All of the valve and operating mechanism is assembled on the dome cover so that the cover and valve is removed and applied as a unit. The dome, in addition to being fitted with a shut-off valve, is also fitted with a filling valve, which injects the feed-water into the boiler at its highest point.

A new feature used on these locomotives is the method of securing the arch tubes to the throat and door sheets. Nickel cast-steel ferrules are used which extend between the inner and outer sheets. The inner and outer ends of the ferrules screw into the inside and outside sheets; the ends project beyond the sheets and are welded in addition to being screwed into position. The body of the ferrule between the sheets is cast with six slots to allow circulation and the arch tube itself is expanded and rolled into the inner end of the ferrule in the usual way, there being an increase in the diameter of the ferrule immediately behind the inner sheet. The usual square-thread arch tube plugs are screwed into the outer end of the arch-tube ferrules.

Alloy Steel Extensively Used

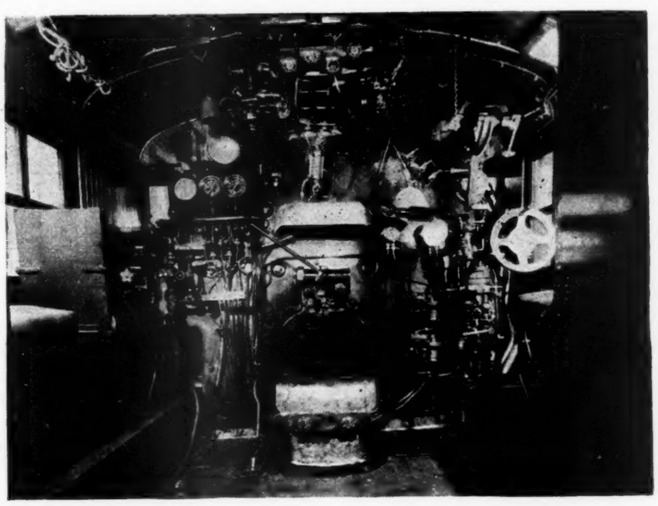
The locomotives are equipped with Commonwealth locomotive steel bed castings with which the bumper beams are cast integral. The cylinders are separate but are of cast steel. The combined assembly of cast-steel cylinders and locomotive bed casting has effected a weight saving of between 4,000 and 5,000 lb. Wheel centers and miscellaneous steel castings, such as pump brackets, guide yokes, piston-head centers, crosshead bodies, link support brackets, etc., are all cast nickel steel. The use of alloy steel for these parts has permitted a reduction in sections from ⅞ in. and one in. to ½ in. and ⅝ in. without any sacrifice of strength. The main and side rods and crank pins are of a low-carbon nickel steel to a new specification so that, taken altogether, there is probably more alloy steel used in the production of the K-1 class locomotives than has heretofore been used in any locomotives.

The engines are equipped with the American multiple-type front-end throttle which is operated by a throttle rod extending from the cam-shaft operating lever through the hand rail on the right side of the locomotive. Incidentally the hand rails, as well as the running-board outer edge angles, are made of sheet aluminum.

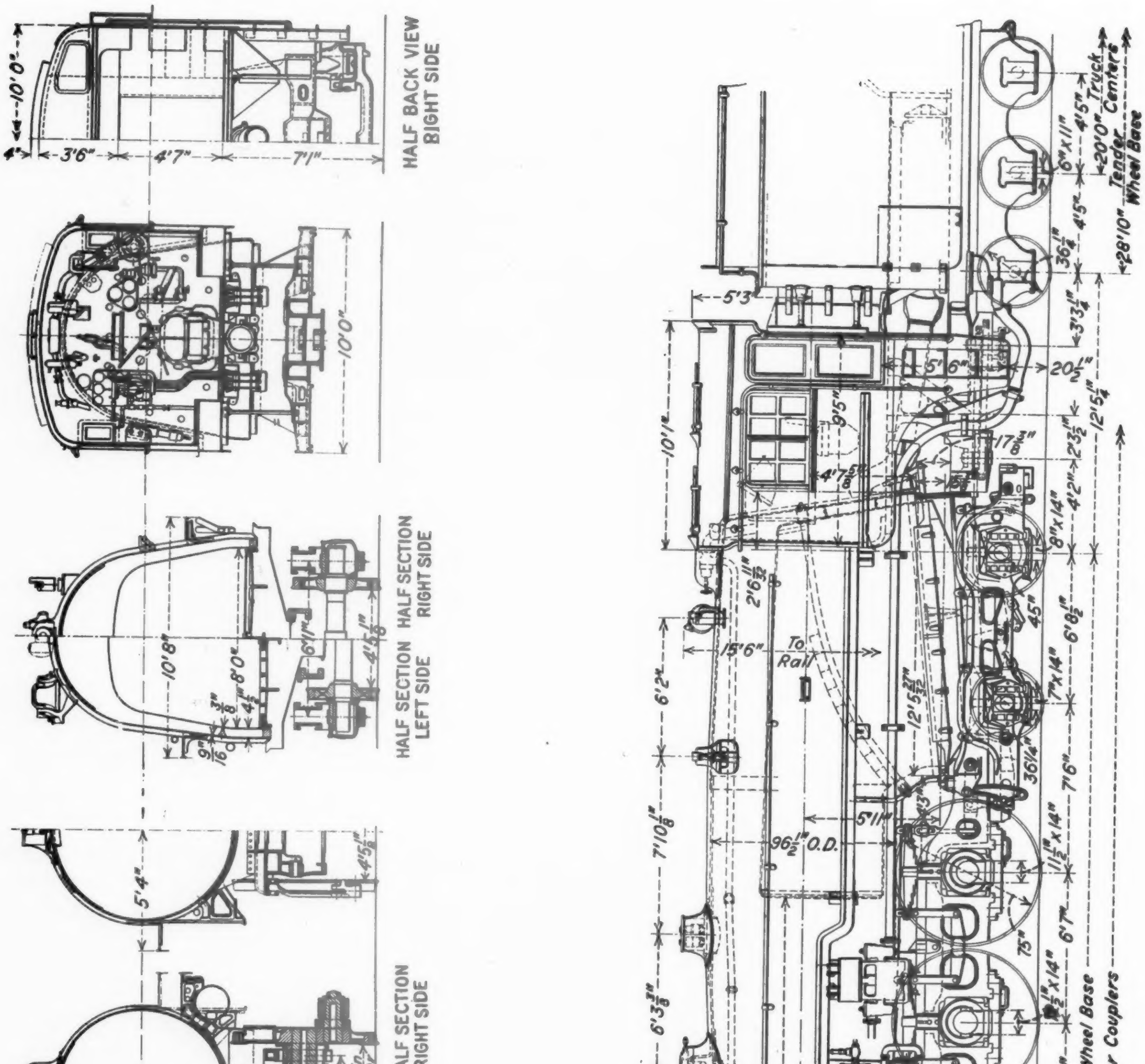
The Franklin tandem main-rod drive has been used experimentally on these two engines. They have also been fitted with both Spee-Dee and Alemite grease cups. Grisco driving boxes have been used on the main and intermediate journals. All boxes are fitted with Franklin spreader castings.

A New Design of Radial Buffer and Unit Safety Bar

A new design of radial buffer has been used between the engine and tender which consists of the usual buffer casting on the locomotive back deck casting and the customary floating wedge. The buffer block on the tender is held in position in the Commonwealth underframe casting laterally and vertically but is free to move endways. The back of this casting is of wedge shape. Two small floating wedges are provided which bear against the inner end of the floating tender buffer casting. Lateral pressure is exerted on these two small wedges by means of double coil springs on which the pressure can be released or increased by adjusting nuts. The whole scheme is somewhat similar to the Cardwell draft gear and provides greater flexibility in maintaining the correct wedge pressure between the engine and tender and also prevents crowding of the wedges in a backing



The locomotives are fitted with spacious vestibule cabs furnished with steel lockers



Cross sections and elevation views of the two 4-8-4 Canadian Pacific locomotives

up movement which has a tendency to cause derailment.

The unit safety bar with which the locomotives are equipped is also of a new design. Up to the present the usual design was to have the drawbar and safety bar in contact at the engine end but separated from each other at the tender end, which gave a sloping safety bar. In the new design the two bars lie flat one on the other, separated by wearing plates. This eliminates the angle safety bar and reduces the depth of the casting required on the tender.

Changes in Reverse Gear Design

The reverse gear is of the Canadian Pacific standard screw type and, on account of improvements made in cab construction, a new design has been provided where only the operating wheel and indicator are inside the cab construction, a new design has been provided where level immediately back of the tumbler shaft and is enclosed within a metal case. The connecting rod from

Table of Dimensions, Weights and Proportions of the C.P.R. 4-8-4 Type Passenger Locomotive

Railroad	Canadian Pacific
Type of locomotive	4-8-4
Service	Passenger
Cylinders, diameter and stroke	25½ in. by 30 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7 in.
Outside lap	1⅛ in.
Exhaust clearance	¼ in.
Lead in full gear	¼ in.
Weights in working order:	
On drivers	250,000 lb.
On front truck	61,000 lb.
On trailing truck	112,000 lb.
Total engine	423,000 lb.
Tender	286,000 lb.
Wheel base:	
Driving	19 ft. 9 in.
Rigid	19 ft. 9 in.
Total engine	45 ft. 9⅜ in.
Total engine and tender	87 ft. ¾ in.
Wheels, diameter outside tires:	
Driving	75 in.
Front truck	33 in.
Trailing truck	Front, 36 in., Rear, 45 in.
Journals, diameter and length:	
Driving, main	12½ in. by 14 in.
Driving, others	11½ in. by 14 in.
Front truck	6½ in. by 12 in.
Trailing truck	7 in. by 14 in., 8 in. by 14 in.
Boiler:	
Type	Conical
Steam pressure	275 lb.
Fuel, kind	Bituminous
Diameter, first ring, inside	84¼ in.
Firebox, length and width	140 3/16 in. by 96 in.
Arch tubes, number and diameter	4, 3½ in.
Combustion chamber, length	5 ft.
Tubes, number and diameter	59, 2¼ in.
Flues, number and diameter	203, 3½ in.
Length over tube sheets	20 ft. 6 in.
Grate area	93.5 sq. ft.
Heating surfaces:	
Firebox, comb. chamber and arch tubes	422 sq. ft.
Tubes and flues	4,509 sq. ft.
Total evaporative	4,931 sq. ft.
Superheating	2,112 sq. ft.
Comb. evaporative and superheating	7,043 sq. ft.
Special equipment:	
Superheater	Type E
Feedwater heater	Elesco
Stoker	Standard Type B. K.
Tender:	
Style	Rectangular
Water capacity	12,000 Imperial gal.
Fuel capacity	20 tons
General data estimated:	
Rated tractive force, 85 per cent	60,800 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	.59
Weight on drivers ÷ tractive force	4.12
Total weight engine ÷ comb. heat. surface	60.1
Boiler proportions:	
Tractive force ÷ comb. heat. surface	9.65
Tractive force × dia. drivers ÷ comb. heat. surface	647
Firebox heat. surface ÷ grate area	4.51
Firebox heat. surface, per cent of evap. heat. surface	8.56
Superheat. surface, per cent of evap. heat. surface	42.8
Combined heating surface ÷ grate area	75.2

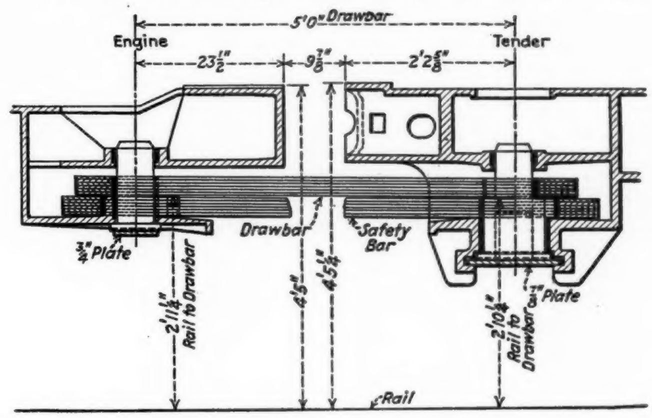
the operating wheel in the cab to the power screw is fitted with two universal joints.

The Cab Arrangement

The cab is of the vestibule type of steel construction insulated with hair felt. The inner finish is tongue-and-groove lumber. The cab itself is spacious, gives ample seating accommodation for three, with a full length locker running from floor to roof, the upper portion of which is a clothes locker for the crew and the lower section a storage locker for accessories.

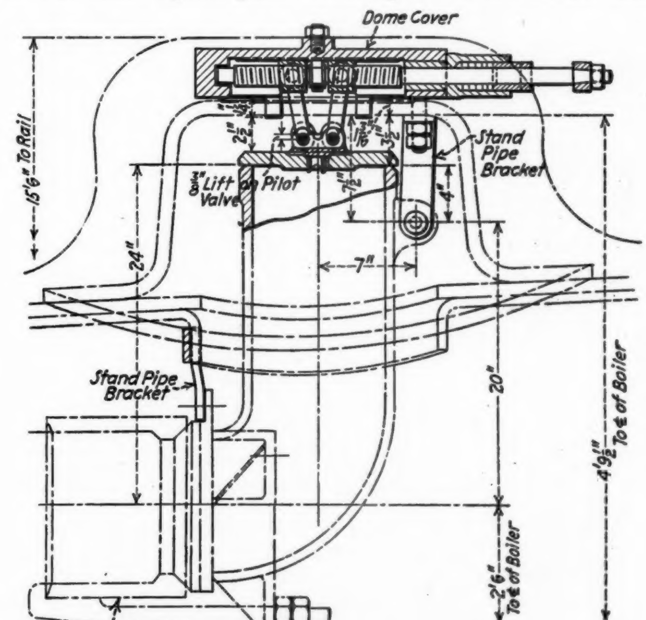
All valves, fittings and gages are carefully arranged for maximum convenience, one feature being that the valves and gages are mounted on two panels, one on the left and one on the right side of the back head. The gages and valves can be assembled in position on the panels which can be applied as units. By breaking pipe connections the panels can be removed intact.

Because of the long wheel base, the movement be-



Arrangement of the drawbar

tween the engine and tender is considerably greater than on previous Canadian Pacific locomotives equipped with vestibule cabs. This has led to a re-arrangement of the vestibule feature between the cab and tender. Instead of the usual apron plate reaching from the tender and

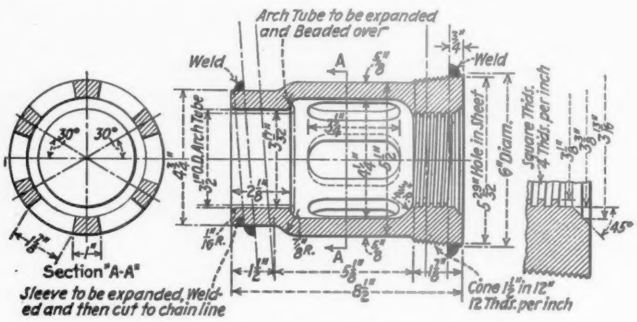


Throttle and dry pipe dome shut-off valve arrangement

moving sideways on the cab deck, a double apron is used. One apron is hinged on the back of the cab and rests on the tender and the other apron is hinged on the tender and supported by the apron plate that is hinged to the rear of the cab. In this way the top apron plate is kept off the cab deck which permits a narrower coat door back of the cab and allows greater side movement

of the diaphragm which, as in past designs, is supported on the tender and is held against a wearing plate on the back of the cab by spring pressure.

Superheated steam is used for the operation of auxiliaries which include the whistle, air compressor, feed-water-heater pump, blower, dynamo, and stoker engine. The main supply line is led back at about running-board level from a shut-off valve and connection on the left side of the smokebox to a distributing turret on the left side of the cab immediately in front of the fireman. From this distributing turret leads are taken to the various auxiliaries as required.



Method of fastening arch tube sleeves

Two lubricators are used, one five-feed Detroit hydrostatic lubricator for valve chests, cylinders and air compressor and a three-feed lubricator for the stoker engine and feed-water-heater pump; the third feed is capped. All superheated steam pipes exposed are covered with sponge felt and jacket lagging. Other distributing pipes are lagged with Johns Manville asbestos tape.

The locomotives are equipped with back-pressure gages.

The Tender

Both four-wheel and trailing engine trucks are the Commonwealth cast steel type. Cast-iron grates, with cast-steel center and side supports, are used, the grates being hand operated. The locomotives are stoker fired with a Standard B.K. type stoker. The stoker engine is carried on the left front corner of the tender and the stoker exhaust is led first to a condensing coil on the back of the coal hopper and from there to the feed-water heater oil separator into which the feed water heater condensate is discharged.

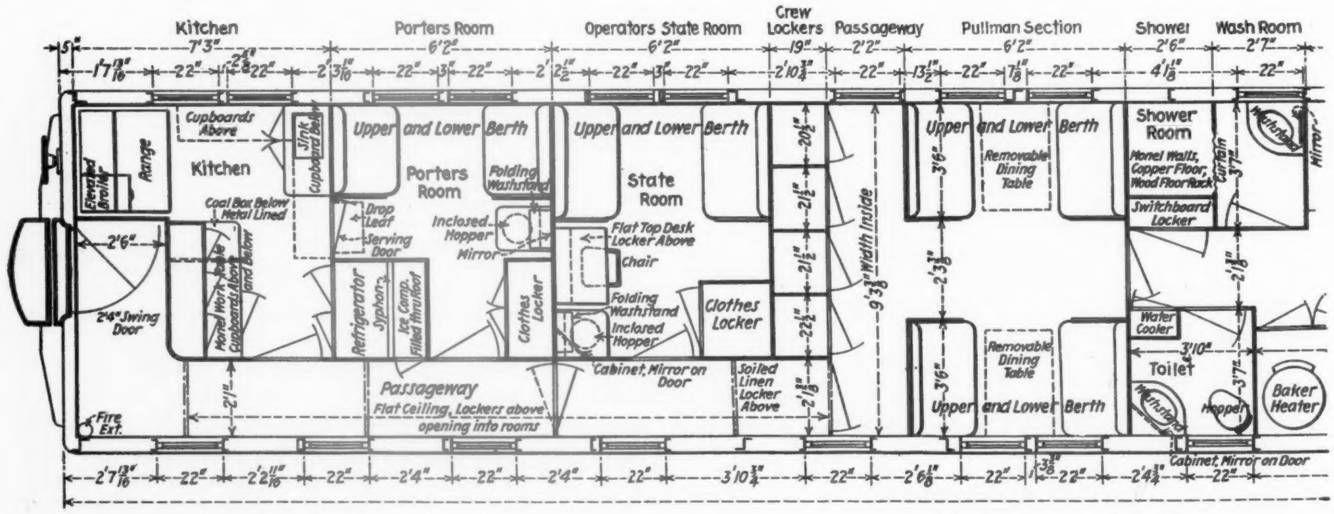
The tender is equipped with Commonwealth water-bottom cast-steel tender underframe and Commonwealth six-wheel trucks fitted with clasp brakes. The tender has a water capacity of 12,000 Imperial gallons and a coal capacity of 20 tons.

Northern Pacific Dynamometer Car

New car, built at Como shops, records drawbar pull up to 250,000 lb.—Large living quarters provided

THE Northern Pacific has recently completed at its Como shops, St. Paul, Minn., an all-steel dynamometer car, which has a dynamometer capacity up to 250,000 lb. drawbar pull and 1,250,000 lb. buff. When the order was placed for the four-cylinder, single-expansion locomotive to develop a maximum tractive force of 153,300 lb.*, it was realized that the dynamometer car then in use on the Northern Pacific, with a maximum capacity of 60,000 lb. drawbar pull, would be entirely inadequate in testing this and other large locomotives. The design and construction of a modern dynamometer car of the required capacity was

* A description of this locomotive appears on page 56 of the February issue of the Railway Mechanical Engineer.



Floor plan, showing the arrangement

Northern Pacific all-steel dynamometer car built at Como shops, St. Paul, Minn.

therefore undertaken. As a result of the experience with the previous car, it was decided that the living accommodations in the new car must be made as large and complete as possible, that a spacious work room should be provided, and that there should also be a large clear-vision cupola for the chronograph table and gages. All of these features have been included in the new car.

This car, No. 276, is 9 ft. 3⅜ in. wide by 70 ft. long inside, and weighs 168,000 lb. It is believed to be the largest dynamometer car in the world. The car has a built-up steel underframe with fish belly center sills 28 in. deep. The cupola end of the underframe is fitted with a ½-in. steel reinforcing floor plate 9 ft. 3⅜ in. wide by 25 ft. 6½ in. long, securely riveted to the side sills and center sills.

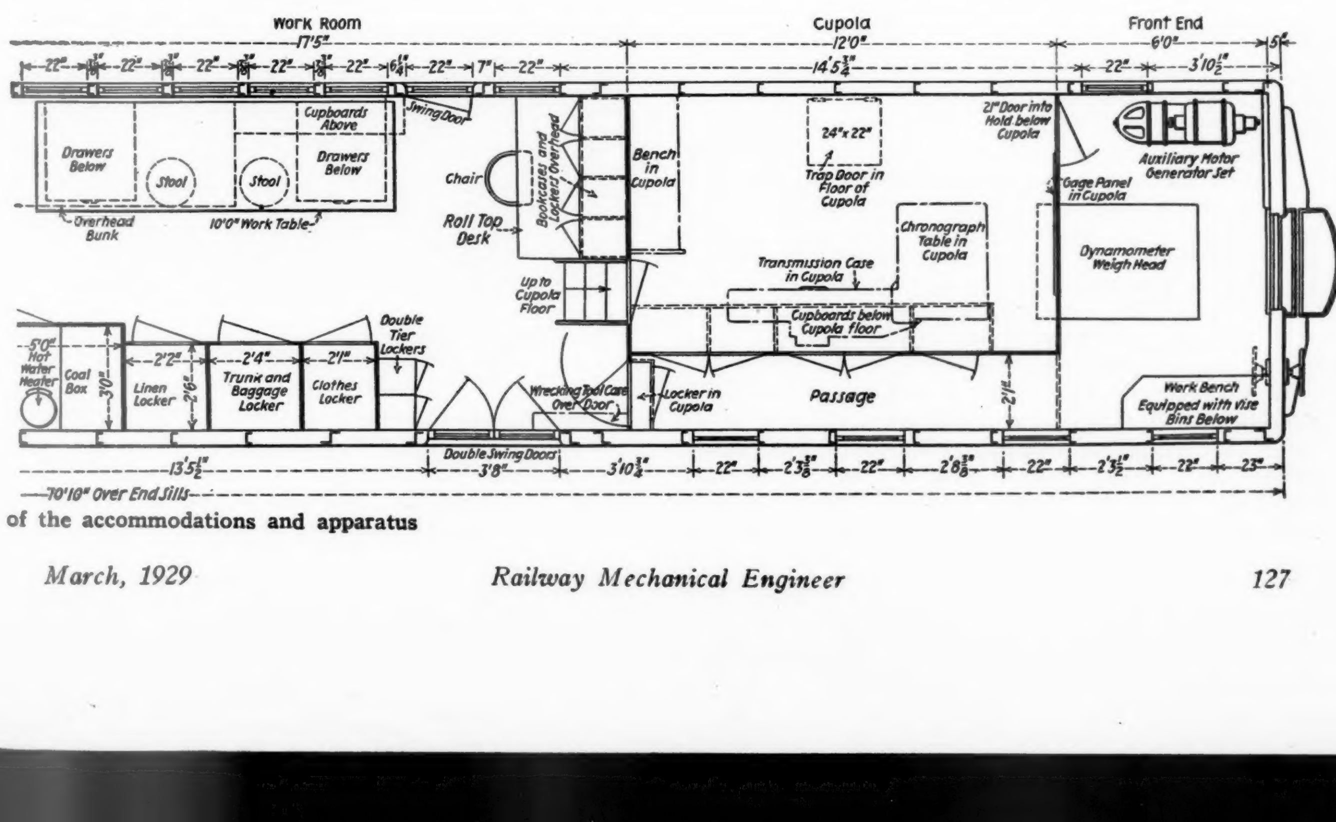
Six-wheel Commonwealth cast steel trucks with 36-in. solid steel wheels are used. All wheels are equipped with clasp brakes, except the rear pair of the front truck. The paper drive is taken from this axle.

The car body is of steel, well insulated and lined with 13/16-in. tongue and groove sheathing. The car proper has 13/16-in. tongue and groove wood floor, all of which is covered with green and red checkered rubber tile, except the kitchen, heater room and shower. The outside is painted Pullman body green, and the inside, with the exception of the kitchen, shower, heater room and the space in front of the cupola, has side walls in old ivory enamel and the ceiling and lower deck in pearl gray.

The space provided for living quarters for the crew occupies 34 ft. 7 in. of the 70 ft. car and consists of a kitchen, porter's room, operator's stateroom, clothes lockers, two berth sections, shower and lavatory.

At the rear of the car is the kitchen, 7 ft. 2⅜ in. wide and 7 ft. 3 in. long. The floor is of copper covered with wood floor racks. The ceiling, lower deck and side walls are painted with a pale green enamel. The kitchen is equipped with a No. 18 Commander range, metal-lined coal box, Monel metal work table, Monel metal sink, large refrigerator, motor-driven exhaust fan and the usual cupboards for dishes and cooking utensils. Suspended from the ceiling in the kitchen are two copper gravity water tanks with a capacity of 126 gal. and a connection to a hot-water coil in the range. Two 18-in. by 24-in. windows in the side of the car and one 7-in. by 25½-in. deck window provide excellent daylight and there are, of course, the usual ceiling and wall electric lights.

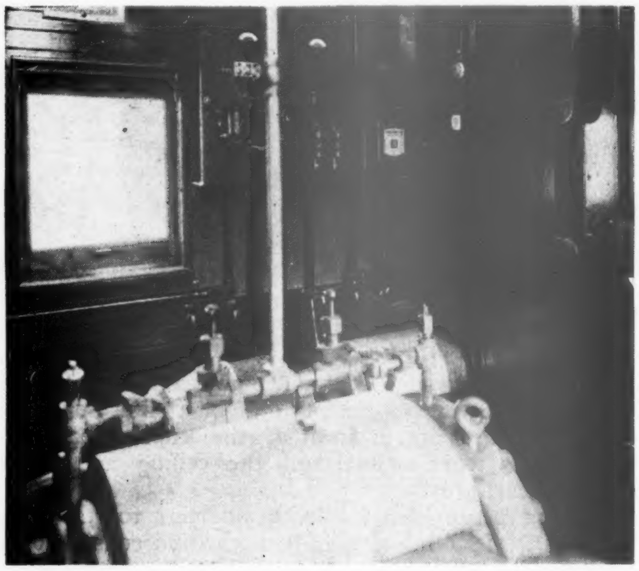
There is a passageway 2 ft. 1 in. wide, with flat ceil-



of the accommodations and apparatus

ing, extending along the right side of the car from the rear to the transverse aisle at the berth sections. Door openings lead from this longitudinal passageway to the kitchen, porter's room and operator's stateroom.

The porter's room, 6 ft. 2 in. by 7 ft. 2⅜ in., is next to the kitchen. There is a serving door with drop leaf shelf in the partition between the kitchen and porter's room, to facilitate serving food to the dining room. The room is equipped with an upper and lower berth,



View of the weighing head in the head end of the car—The motor generator set for charging batteries and charging panel are in the far corner

clothes locker, folding washstand with mirror above, enclosed hopper and a 9-in. electric fan.

Adjacent to the porter's room is the operator's stateroom, 6 ft. 2 in. by 7 ft. 2⅜ in. This is equipped with an upper and lower berth, large clothes locker, flat top desk with cabinet above, chair, folding washstand with cabinet and mirror above, an enclosed hopper and 9 in. electric fan. In addition to serving as a bedroom, this is used by the operator as an office for working up reports and handling correspondence.

In the passageway between the porter's room and the operator's stateroom is a swinging door which serves to keep kitchen odors from the main body of the car. There is also a hinged door at the forward end of the longitudinal passageway, which serves to shut off the entire rear of the car from the front when desired. The passageway has five 18-in. by 24-in. side windows and suitable electric lights on the side wall. Lockers have been built into the space above the ceiling of the longitudinal passageway with openings into the kitchen, porter's room and the stateroom. The longitudinal passageway terminates in a transverse passage 2 ft. 2 in. wide by 9 ft. 3⅜ in. long. Built against the stateroom and facing the transverse aisle are four built-in individual clothes lockers 21½ in. wide by 19 in. deep with a chest of drawers below. These lockers and drawers provide excellent space for the clothing of the crew.

Two Pullman sections located next to the transverse aisle furnish sleeping accommodations for the assistants. By the use of removable tables, this space is also utilized as a dining room during the day. There are two 18-in. by 24-in. windows and one 7-in. by 25½ in. deck window on each side of this Pullman section. Artificial illumination is furnished by ceiling lights and there is one 12-in. electric fan for ventilation.

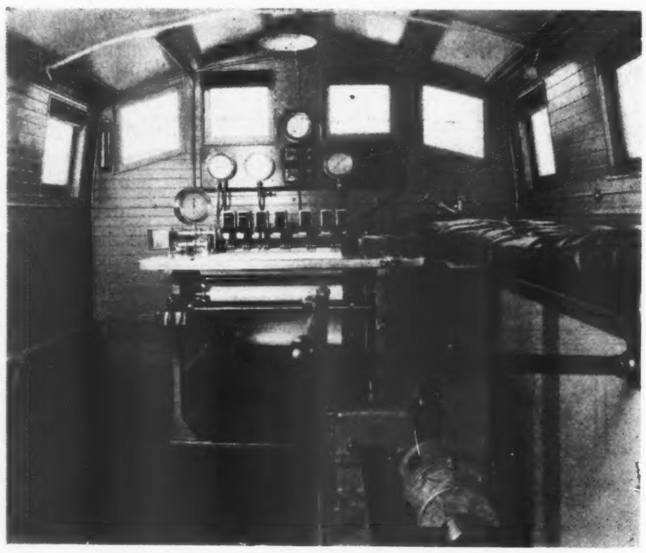
On the left side of the car next to the Pullman section is the shower room and a wash stand. The shower room, 2 ft. 6 in. by 2 ft. 8 in., has Monel metal walls and a copper floor, with wood floor rack, and is supplied with hot and cold water. The opening from the wash room into the shower is covered with a canvas curtain. In the wash room is a white enamel corner wash stand with a mirror above. The switchboard locker is built against the inside wall of the shower and its door opens from the center aisle of the car.

Across the car from the shower and wash room is the toilet. This is 3 ft. 7 in. by 3 ft. 10 in. and contains a wash stand, with a cabinet and mirror above, and a Duner hopper. There is a hinged door in the partition between the Pullman sections and the front of the car A galvanized Geisel water cooler is readily accessible from the aisle between the shower room and the toilet.

Heating and Lighting Equipment

On the right side of the car next to the toilet is the heater room, 3 ft. by 5 ft. The doors to this open from the center of the car and it is lined with galvanized iron. In the heater room is a hot-water Baker heater, which heats the entire car, a No. 1 International laundry heater for providing hot water, and a coal box.

A safety 4-kw. 32-volt axle generator is belt-driven from the rear truck. The battery equipment consists of a 600-amp. hr., 32-volt Exide storage battery mounted in battery boxes underneath the car. In view of the fact that the dynamometer car operates mostly in freight service and that slow speeds usually prevail, the axle generator has been arranged to cut in when a car speed of 7½ miles an hour is attained. All rooms have been amply supplied with electric lights with suitable control switches. Mounted on each side sill under the cupola is an adjustable electric light with a reflec-



Interior view showing the chronograph table, speed recorder, electric clock, gages, etc.

tor for locating mile posts at night. The switches for these lights are located in the cupola.

Since the car is liable to be at terminals and outlying points for several days at a time, where no facilities for charging storage batteries are available, a motor-driven

generator was installed in the front left hand side of the car. This consists of a Westinghouse Type AR single-phase, 110-volt, 60-cycle motor, directly connected to a 3-kw., 40-volt, type SK, generator, with suitable starting compensator and charging panel. This unit operates at 1,750 r.p.m. on either 110- or 220-volt alternating current.

In addition to the two water tanks mounted in the kitchen, there are two copper water tanks, one hot water and one cold water, secured from the ceiling between the shower room and the toilet. There is also a 135-gal. air-pressure cold-water tank underneath the car. The total water storage capacity of gravity hot-water tanks is 126 gal., and of gravity cold water, 126 gal. The water-carrying capacity of the car is 387 gal.

Under the cupola is an electric air compressor for furnishing air for the air-pressure water tank under the car, when not coupled in a train. This is a motor-driven Curtiss air compressor, style W-1, 1⅝ in. by 2 in., operating at 500 r.p.m. and delivering 1.10 cu. ft. of air per minute, equipped with an automatic switch which cuts in at 10 lb. air pressure and out at 25 lb.

Cupola

Six feet from the front of the car is the cupola, 7 ft. 1-13/16 in. wide at the raised floor, 9 ft. 3⅜ in. wide 2 ft. 8¼ in. above the cupola floor, and 12 ft. long. This arrangement provides a passageway on the right side of the car 2 ft. 1 in. wide by 6 ft. 2 in. high under the cupola, and extending from the work room at the rear of the cupola to the front of the car. The roof is curved with a free height at the center of 7 ft. ½ in. The distance from the car floor to the bottom of the cupola floor is 3 ft. 5⅜ in. The floor of the cupola is of 2-in. tongue and groove lumber covered with green and red checkered rubber tile and laid on a ⅜-in. steel reinforcing floor plate supported on 3-in. by 3-in. by ⅜-in angles. The space below the cupola is totally enclosed, with a door at the head end and a trap door above in the floor of the cupola. This provides excellent space for storing paper and miscellaneous supplies. The space in the cupola over the aisle passageway is covered with cushions and furnishes seating accommodations for visitors. A bench at the left of the cupola door and chairs furnish additional seating capacity. Beneath the cupola are four cupboards on the aisle side with doors opening from the aisle. Excellent natural illumination of the cupola is provided by two sliding and one stationary window in each side of the car, each 15 in. by 20 in., four 10½-in by 12-in. stationary windows in the front, and two 10½-in. by 12-in. stationary windows in the rear. In order to see stations and mile posts in inclement weather, a portable storm hood has been built, which fits into the opening of the sliding windows on either side. This hood has glass at the front and rear and thus affords a good view both forward and backward. Anyone in the cupola has a very good view toward the front, both sides and the rear.

Work Room

The work room in this car extends from the wash room forward to the cupola and has a total length of 17 ft. 5 in. The two main doors used for entrance and exit are located in the work room, the one on the left side being a single 22-in. swing door and that on the right a 3-ft. 8-in. double swing door.

On the left side of the car, just ahead of the wash room, is a 3-ft. by 10-ft. oak top work table with winding rolls at each end for handling the rolls of paper. There are five 18-in. by 24-in. windows in the side of the car, facing the work table and the illumination is excellent for working on the rolls. Under the table at each end is a tier of drawers, very useful for storing data, gages, planimeters, etc. The space under the work table in the center has been left open to the floor so that one may sit up to the table in a comfortable position when working on the rolls. Above the work table at one end is an overhead berth for emergency use in case the other sleeping accommodations should at times be insufficient. Above the work table at the other end are cupboards for filing profiles and data.

On the opposite side of the car are built-in linen, trunk and baggage clothes lockers and steel overall lockers.

Between the stairs leading to the cupola and the left side of the car is a roll-top desk with a chair, and with book cases and lockers overhead. In the side of the car at the left is an 18-in. by 24-in. window. Artificial illumination is by means of ceiling-suspended electric lights and a row of wall-mounted lights, with reflectors over the work table. A 12-in. electric fan is mounted at each end of the work room. This work room, which is 17 ft. 5 in. long, is, perhaps, one of the largest ever built in a dynamometer car, and permits the working up of data and reports expeditiously.

Dynamometer Equipment

The complete dynamometer equipment, consisting of the weighing head, axle drive for paper, chronograph table, speed recorder, integrator, electric clock, gages, etc., were purchased as a unit from the Baldwin Locomotive Works. The weighing head is located on the main floor of the car, on the center line. just ahead of the cupola, where it is rigidly bolted to the car underframe. The weighing head is of the diaphragm type with a drawbar-pull piston at the rear and the buff piston at the front. The diaphragms are of leather and the liquid used between the pistons and the cylinder heads is a mixture of glycerine and alcohol. The effective area of the drawbar-pull piston is 100 sq. in. and of the buff piston 200 sq. in. The yoke in the weighing head gives a 2-½ to 1 ratio between the center line of draft and the knife edge contacts at the center of the weighing head. The connections from the drawbar-pull and buff ends of the weighing head up to the chronograph table are ½-in. extra heavy pipe with suitable extra heavy valves. The fulcrum in the vertical yoke between the drawbar and the weighing head has roller bearings with Alemite lubrication. The pistons in the weighing head are supported on ball bearings. The total maximum permissible movement of the pull and buff pistons is about ⅜-in. in either direction from the center. Jack screws in the weighing head lock the lever in central positions when the car is not being used. When testing, each jack screw is backed off about ¼-in. to permit free movement of the pistons. An electric bell in the cupola rings in case the yoke lever comes in contact with the jack screw while testing, which indicates that there is insufficient liquid in the weighing head.

The paper drive is taken from the rear axle of the front truck through spiral gearing and a vertical shaft extending up to the speed-change box on the floor of the cupola. A square jaw clutch in the axle gear case and which is controlled from the cupola, engages or disengages the paper drive. By means of the speed-change box in the cupola, three paper speeds can be obtained from the axle drive, i.e., 3.30 in., 13.20 in., and 52.80 in. per mile of car travel. The intermediate speed of 13.20 in. per mile is found to be most practical for ordinary work. The motor in the cupola used in

connection with the speed recorder and indicator drive can also be used for paper drive in case it is desired to take records of some events when the car is not in motion, or drive the paper at a definite number of inches per minute instead of per mile of car travel. The three paper speeds from the motor drive are at the rate of 3-¾ in., 15 in. and 60 in. per min. A small lever at the right of the operator's chair with three notches, provides for neutral position, motor drive of the paper or axle drive of the paper. For general work, the axle drive at a fixed paper travel per car mile is the most convenient and practical.

The motor that drives the speed recorder and indicator and the speed change box used in connection with the paper are mounted on the floor at the right of the operator's chair.

The paper used on the chronograph table is 24 in. wide and the movement is toward the operator.

The bridge bars spanning the table carry supports for 22 recording pens. The events recorded by these pens in consecutive order from the left to the right of the paper are as follows: Six-second intervals, brake cylinder pressure, right water meter, left water meter, brake-pipe pressure, front air pump, back air pump, steam pressure, coal or oil meter, feedwater pump, back pressure, locomotive indicator, integrator, drawbar pull, buff, reverse lever, throttle, speed, distance marks, mile post and station locations, one-minute intervals, six-second intervals.

Datum reference lines are necessary for brake-cylinder pressure, brake-pipe pressure, back pressure, steam pressure, drawbar pull, buff and speed. These datum lines are marked on the paper by aluminum rollers mounted on a shaft extending across the table at the front. These rollers have a very sharp flange, which marks the datum line, and a tread on which is a rubber stamp, designating what the line above each base line represents. Inking pads are in contact with each roller at all times and the line made by the flange is very fine and comparable with that made by a pen. There is a decided advantage in recording datum lines in this manner as it removes seven pens from the main bridge bars and means fewer pens to watch and keep working. So far as is known, this is the first time this arrangement has been utilized in such a car.

Records of brake-cylinder pressure, brake-pipe pressure, back pressure, steam pressure and buff are obtained through steam indicators, mounted on the left top of the chronograph table, the pencil motion of each indicator being extended through levers to the proper position on the table.

The cylinder from which the drawbar pull record is obtained is rigidly mounted on the front right top of the chronograph table. Pressure from the drawbar-pull cylinder in the weighing head is piped to the drawbar-pull cylinder on the table. Movement of the piston in this small cylinder is resisted by a calibrated spring, one end of which is securely fastened to the piston rod. The drawbar-pull pen arm, the full travel of which is 3 in., derives its motion through a lever from the above piston rod. By changing springs, a full 3-in. movement of the drawbar-pull pen is obtained with a drawbar pull of either 25,000, 50,000, 75,000, 100,000, 150,000, 200,000, or 250,000 lb.

The integrator is fastened on top of the chronograph table at the front and makes one revolution for each three square inches area between the datum line and the drawbar-pull line. Each revolution of the integrator is recorded on the paper as a notch, by means of a commutator on the integrator shaft, a pilot relay and pen-arm relay.

On the right top of the chronograph table are eight of the latest type Veeder electrically-operated counters. These record the number of integrator notches, number of 100-ft. distance marks, revolutions of left water meter, revolutions of right water meter, revolutions of coal or oil meter, strokes of front air pump, strokes of back air pump and strokes of feedwater pump.

Near the speed-change box, on the floor of the cupola, at the right of the operator is a ¾-hp. 30-volt General Electric constant-speed motor for operating the speed recorder and indicator, and the paper drive when desired. On the end of the motor shaft is a governor which holds the speed very close to 1,725 r.p.m. and final adjustment of speed is by means of a face-plate rheostat connected in series with the motor field. On top of the motor is a small panel on which is mounted a voltmeter and a motor speedometer.

The speed recorder and indicator, an ingenious device developed by the Baldwin Locomotive Works, is mounted on top of the chronograph table at the right, and consists of a horizontal disc, driven at constant speed from the ¾-hp. motor and a vertical disc resting on the horizontal disc and driven from the car axle. When the car is at rest, the vertical disc is stationary and occupies a position at the exact center of the horizontal disc, which is, of course, revolving at constant speed. When the car is in motion, the vertical disc is revolving and occupies a position on the horizontal disc where the peripheral speeds of the two discs are equal. The carriage supporting the vertical disc and its shaft moves on rollers with the longitudinal movement of the disc, and this movement of the carriage actuates the speed-indicator gage and also produces a graphical record of speed on the chart paper. The speed indicator gage is mounted in a vertical position on top of the table at the left of the operator where it is easily read by anyone in the cupola. A small lever at the right top of the table controls the speed indicator and recorder drive. With the lever in central position, the speed device is in neutral; when moved to the left the indicator and recorder give the true car speed and when moved to the right, double the car speed is indicated and recorded.

Mounted on the side of the longitudinal seat at the right side of the cupola, close to the operator's chair, is the selective switch box with a master switch and marked individual switches for each electrical circuit in the cupola and those extending in a cable from the cupola to the locomotive cab and pilot. A telephone in the cupola and one in the locomotive cab afford a means of communication between the operator and the assistant. The circuits extending from the switch box and table to the locomotive are enclosed in a cable terminating in a junction box.

At the front right corner of the cupola is a dead-weight gage tester for calibrating the drawbar-pull indicator and recorder as well as all other pressure-recording indicators.

On the front wall of the cupola, below the windows, is the oak gage board on which is mounted a Seth Thomas clock, duplex air gage, steam-pressure gage, drawbar-pull gage, clock relay, integrator relay and weighing-head alarm bell. The clock is so arranged that electrical contact is made every minute and this is indicated on the paper. The two six-second marks on the paper are timed from the constant speed motor.

On the chronograph table and at each sliding window in the cupola is a button switch for indicating the location of stations and mile posts.

Examples of Recent Switch Engines of the 0-6-0, 0-8-0 and 0-10-0 Types

General Dimensions, Weights and Proportions

Type	0-6-0	0-6-0	0-6-0	0-6-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-8-0	0-10-0	0-10-0
Railroad	U. S. R. A.	S. A. L.	Penna.	Union	U. S. R. A.	I. C.	H. V.	C. & N. W.	T. & P.	C. St. P. M. & O.	B. & M.	O. I. M.	C. R. R. of N. J.	L. & N. E.	Penna.	I. H. B.	C. & O.	D. M. & N.
Road class	......	F-7	B-6sb	......	......	......	S-9	M-4	C-2-A	M-5	H-3-a	......	......	......	C-1	U-4	......	S-6
Road number	......	1118	4179	165	......	3540	100	2640	490	60	640	700	313	131	6556	102	59	90
Builder	A. & B.	Bald.	R. R.	Lima	A. & B.	Bald.	Lima	Amer.	Bald.	Bald.	Bald.	Lima	Bald.	Bald.	R. R.	Amer.	Amer.	Bald.
Date built	1918	1927	1926	1926	1918	1927	1926	1927	1927	1928	1927	1927	1927	1927	1927	1927	1918	1927
Tractive force, engine, lb.	39,100	45,000	36,144	42,900	51,000	51,040	51,200	54,000	54,500	58,400	56,800	55,500	61,422	68,500	76,155	75,700	63,000	77,600
Tractive force, booster or aux. loco., lb.	......	......	......	......	......	......	......	......	15,000	......	......	14,000	......	......	......	13,800	......	14,500
Cylinder horsepower (Cole)	1,509	1,951	1,786	1,655	1,970	1,970	1,970	2,083	2,177	2,252	2,815	2,142	2,387	2,755	3,280	2,985	2,427	3,469
Engine and Tender Data																		
Weight of engine, lb.	165,000	180,000	180,300	186,000	214,000	221,460	223,400	231,000	232,800	238,930	244,800	254,000	255,090	269,800	278,000	294,000	295,000	352,250
Weight on drivers, lb.	165,000	180,000	180,300	186,000	214,000	221,460	223,400	231,000	232,800	238,930	244,800	254,000	255,090	269,800	278,000	294,000	295,000	352,250
Weight of tender, loaded, lb.	144,000	165,300	125,000	127,500	167,900	154,840	164,800	208,000	196,000	179,970	176,200	194,300	169,610	178,200	156,000	221,300	183,100	202,950
Tender, water capacity, gal.	8,000	8,000	6,350	7,000	8,000	8,000	8,000	12,000	9,500	10,000	10,000	10,000	9,000	10,000	7,300	12,000	10,000	10,000
Tender, fuel capacity, tons or gal.	16	16	7	7	16	13	16	16	3,000	12	13	10	13	14	15½	15	15	14
Wheel base, engine, ft. and in.	11—0	12—0	11—6	11—0	15—0	15—0	15—0	15—0	15—0	15—0	15—0	15—0	15—3	16—0	15—9	16—4	19—0	20—10
Wheel base, engine and tender, ft. and in.	49—3½	52—1	49—3¼	45—5¾	53—0½	53—3½	53—0½	59—4¾	55—4½	54—9¾	54—10½	56—10	54—6⅞	56—8¾	53—5½	56—9¾	60—3¼	65—11¾
Cylinders, diameter and stroke, in.	21x28	23x28	22x24	22x28	25x28	25x28	25x28	25x28	22x28	25x28	25x28	23x28	24x30	27x30	27x30	Note 1	27x28	28x30
Driving wheels, diameter, in.	51	51	56	51	51	51	51	51	51	51	51	50	55	57	56	57	51	57
Boiler Data																		
Steam pressure, lb.	190	205	205	190	175	175	175	185	250	200	250	225	230	210	250	200	185	245
Fuel	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Soft coal	Oil	Soft coal	Soft coal	Soft coal	H. & S. coal	H. & S. coal	Soft coal	Soft coal	Bit. coal	Bit. coal
Boiler, diameter, first ring, in.	66	70	67⅛	72	78 9/16	80	80	78 9/16	78	80	80	82	78⅛	88	78½	86	82	88
Firebox, length, in.	72⅛	78⅛	111	77⅝	102⅛	102⅛	102⅛	102⅛	102 1/16	102⅛	102⅛	108⅛	121⅝	126⅛	111	102⅛	108⅛	120
Firebox, width, in.	66¼	72	79⅞	72¼	66¼	72	66¼	66¼	75¼	66¼	66¼	84¼	108⅛	108¼	79⅞	102¼	96¼	96¼
Tubes, number and diameter, in.	158—2	160—2	194—2	183—2	232—2	221—2	230—2	187—2	199—2	165—2	226—2	180—2¼	208—2	277—2	269—2	315—2	217—2¼	214—2¼
Flues, number and diameter, in.	24—5½	26—5½	26—5½	28—5½	36—5½	36—5½	36—5½	36—5½	34—5½	45—5⅜	36—5½	43—5½	34—5½	53—5½	40—5½	50—5½	45—5½	53—5½
Length over tube sheets, ft. and in.	15—0	15—0	12—4	15—0	15—0	15—0	15—0	15—0	15—0	14—6	15—0	14—0	15—0	14—4	15—0	16—0	18—1	19—0
Grate area, sq. ft.	33	39	61.6	38.9	47	51	47	47	53.4	47	47	63	91.7	95	61.6	72.5	72.3	80
Heating surface, firebox, total, sq. ft.	138	164	195	165	208	248	214	263	231	227	214	230	240	258	237	248	232	344
Heating surface, tubes and flues, sq. ft.	1,748	1,808	1,715	2,028	2,569	2,499	2,569	2,215	2,284	2,157	2,538	2,334	2,354	3,155	2,977	3,769	3,466	3,829
Heating surface, total evap., sq. ft.	1,886	1,972	1,910	2,191	2,777	2,747	2,783	2,478	2,515	2,384	2,752	2,564	2,594	3,413	3,214	4,017	3,698	4,173
Superheating surface, sq. ft.	442	452	354	506	614	638	610	652	574	739	603	680	574	902	741	953	935	1,170
Comb. evap. and super. surface, sq. ft.	2,328	2,424	2,264	2,697	3,391	3,385	3,393	3,130	3,089	3,123	3,355	3,244	3,168	4,315	3,955	4,970	4,633	5,343
Proportions and Ratios																		
Weight on drivers ÷ tractive force	4.22	4.98	4.99	4.33	4.19	4.34	4.36	4.27	4.27	4.09	4.31	4.58	4.15	3.94	3.61	3.88	4.68	4.54
Weight of engine ÷ comb. h. s.	70.8	74.3	79.6	69.0	60.2	65.5	65.4	73.8	75.3	76.5	73.0	78.3	80.5	62.6	70.3	59.2	63.7	65.9
Firebox surface per cent evap. h. s.	7.32	8.32	10.20	7.53	7.49	9.03	7.69	10.62	9.19	9.52	7.78	8.97	9.25	7.56	7.39	6.17	6.28	8.24
Firebox surface ÷ grate area	4.18	4.20	3.16	4.24	4.43	4.86	4.55	5.60	4.33	4.83	4.55	3.65	2.62	2.71	3.85	3.42	3.21	4.30
Superheat. surface per cent comb. h. s.	19.0	18.6	15.6	18.8	18.1	18.8	18.0	20.8	18.6	23.6	18.0	21.0	18.1	20.9	18.2	19.2	20.2	21.9
Tractive force ÷ comb. h. s.	16.8	18.5	16.0	15.9	15.9	15.1	15.1	17.2	17.6	18.7	16.9	17.1	19.4	15.9	19.25	15.2	13.6	14.5
Tractive force × dia. drivers ÷ comb. h. s.	857	946	894	811	812	769	770	880	900	954	864	855	1,065	905	1,078	868	693	828
Comb. heat. surface ÷ grate area	70.6	62.2	36.8	69.3	72.2	66.4	72.2	66.6	57.9	66.4	71.4	51.5	34.5	45.4	64.2	68.5	64.1	66.8
Notes	b	b	a	b	a	b-d	b	a-d	b-d-f-g	b	b-e-f	b-e-f-g	b	b	a-f	a-e-g	a	b-d-f-g

Key to notes: a—Boiler diam., inside; b—**Boiler diam.**, outside; d—Syphon; e—Feedwater heater; f—Limited cut-off; g—Tender booster.
Note 1—Three cylinder inside 23½ x 28, outside 23½ x 32.

The Characteristics of Injectors*

Feedwater heating effect of the exhaust steam injector—Comparison of injectors and pump feedwater heaters is discussed

By R. M. Osterman
Vice-President, The Superheater Company, Chicago

Part II

FIG. 10 shows a group of curves which denote limits of stability of a No. 10 Elesco injector when handling certain quantities of water of various temperatures from the supply tank and when operated with varying exhaust-steam pressures against a boiler pressure of 190 lb. gage. The curves were experimentally obtained in the laboratory with 175 lb. supplementary steam pressure and a supplementary nozzle of 9 mm. bore, which permitted a constant supplementary steam flow of about 910 lb. per hr. The curves clearly indicate the influence of suction-water temperature upon feed range as well as upon the injector's ability to remain stable with fluctuations of exhaust-steam pressure. If 21,000 lb. of feedwater of 80 deg. temperature be admitted to the injector, it is at once apparent from the curves in No. 10 that the exhaust-steam pressure may vary between 0 and 13 lb. above atmosphere without endangering the performance of the injector. It also can be seen from these curves that with 80 deg. and 6 lb. exhaust pressure the quantity of water taken from the tank may be varied from 25,000 lb. per hr. to 18,000 lb. per hr. which corresponds to an approximate range of from 72 to 100 per cent, a creditable performance at the relatively high suction temperature. With water as cool as 50 deg. F., a range of about 50 per cent can be had over a considerable range of exhaust steam pressures, and in general it can be concluded from the character and import of these curves that locomotive engineers should have, generally speaking, no trouble in getting along with injectors of such characteristics in territories in which extraordinarily high suction water temperatures, say in excess of 80 deg. F., are not encountered. An Elesco exhaust-steam injector can, as will be noticed, handle water in excess of a temperature of 90 deg. F., but a satisfactory stability could no longer be maintained automatically under conditions of varying water quantities and under conditions of the influence of varying exhaust-steam pressures. With extremely high water temperatures the locomotive engineer or fireman, or whoever operates the injector, occasionally has to readjust the quantity of water fed whenever the exhaust pressure widely varies, so that under such extreme suction-water temperatures even the Elesco exhaust-steam injector is then not as automatic in its action as the designer would like to have it.

From the delivery temperatures which were obtained with the Elesco No. 10 injector and from its corresponding values of W, the weight of the water handled from the tank, of suction-water temperature t_s, and of exhaust-steam pressure, we can calculate the saving of water and the saving of fuel in the following manner:

If S_e = weight of exhaust steam condensed per hour
S_s = weight of supplementary steam condensed per hour
H_e = total heat in exhaust steam per pound above 32 deg. F.
H_s = total heat in supplementary steam above 32 deg. F.

a simplified equation [b] can be written as follows:

$$W\,(t_s - 32) + S_e \times H_e + S_s \times H_s = (W + S_e + S_s)\,(t - 32) + \frac{r}{L}\,(W + S_e + S_s)\,P_1 \quad \ldots\ldots\ldots\ldots [1b]$$

As will be noticed, the kinetic energy of the water entering into the combining nozzle under the pressure of the atmosphere was neglected on the left side of the equation, but to compensate for it in some measure the gage pressure P_1, and not the absolute pressure P, was introduced into the second member on the right side of the equation.

Further introducing

P_1 = 190 lb
S_s = 910 lb. per hr. (which was calculated by Napier's formula for 175 lb. supplementary-steam pressure)
H_s = 1141.8 (being the total heat of steam of 175 lb. gage pressure)
r = 2.36 ft. (being a good average for water temperatures within the injector)

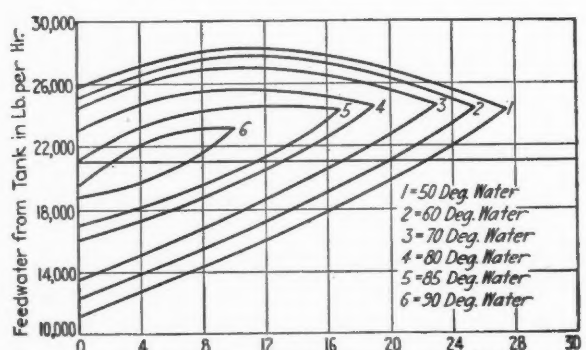


Fig. 10—Maximum and minimum capacities of a No. 10 Elesco injector—Delivery pressure, 190 lb. per sq. in.; supplementary steam pressure, 175 lb. per sq. in.

and solving for S_e, we obtain the following equation:

$$S_e = \frac{W\,(t - t_s + 0.576) - 1{,}068{,}575}{H_e - t + 31.424} \quad \ldots\ldots\ldots\ldots [3]$$

In Table IV, columns 1, 3, 4, 5, and 6 contain quantities established by the same tests that enabled us to plot the set of curves in Fig. 10; column 7 con-

* Abstract of a paper and discussion presented by the Railroad Division at the annual meeting of the American Society of Mechanical Engineers, New York, December 3 to 7, 1928.

tains the pounds of exhaust steam calculated from equation [3].

By addition of S_e in column 7 to the values of W in columns 5 and 6 we obtain the values of W_t, which are the amounts of water evaporated in the boiler and which go to the main cylinders and auxiliaries (the latter with the exception of the exhaust-steam injector itself). The actual total evaporation is $W_t + S_s$; however, it can be assumed that all of the heat in S_s re-enters the boiler, so that the heat in W_t *only comes* from the fuel.

The saving in water that can be effected through the use of the exhaust steam injector is calculated as m.

$$m = S_e/Wt \times 100 \qquad [4]$$

and the value of m is contained in column 10.

The saving in fuel in percentages is equal to the heat saving in percentages that is effected through the condensation of exhaust steam and the return of its heat to the boiler, provided we assume the boiler and furnace efficiency of the locomotive not to have been affected by the reclamation of B.t.u. from the exhaust. With this assumption, which is proper on all locomotives with amply large grates and heating surfaces, the fuel saving in percentages is calculated as

$$n = \frac{Q_e}{Q_s} = \frac{\text{heat added to W by exhaust steam}}{\text{heat in } Wt} \qquad [5]$$

Q_e is contained in column 11 and was calculated from column 7 and column 2, which latter contains the heat contents of the exhaust steam at the various exhaust-steam pressures assumed to be dry-saturated. Q_s was calculated with the assumption that 90 per cent of W_t, the total amount of steam going to main cylinders and auxiliaries, was evaporated at 190 lb. pressure and superheated to 600 deg. F. for the consumption of the main cylinders, whereas the balance of 10 per cent was assumed to be generated at the same pressure of 190 lb., but was used as saturated steam for the auxiliaries, a condition which is true for many superheated-steam freight locomotives in this country which are stoker-feed. Q_s was found to be from the equation.

$$Q_s = 1299.8\ Wt \qquad [6]$$

The values of Q_s are contained in column 12 and the values of n in column 13.

The calculations have been carried through in Table IV for suction-water temperatures of 50, 60, 70, and 80 deg. F. The values of m, representing the water saving in percentages, were plotted in Figs. 11 to 14, and the fuel savings n in percentages in Figs. 15 to 18.

Each one of the figures shows two curves representing the maxima and minima of fuel and water savings obtainable within the range of operating conditions that correspond to the group of curves in Fig. 10. The actual operation of the injector will be carried on somewhere within the limits of stability that are recorded in Fig. 10, and the fuel and water savings will be somewhere between the minimum and maximum curves in Figs. 11 to 14 and Figs. 15 to 18. The maximum fuel and water savings correspond to the minimum ratios of W/S_e, with which the injector could be operated without spill at the overflow, and the minimum fuel and water savings correspond to the maximum ratios of W/S_e with which the injector overflow remained dry.

It will be noted that the percentages of fuel and water saving are of considerable magnitude. The curves prove that with properly designed exhaust-steam injectors very appreciable feedwater-heating effects can be obtained and that this type of apparatus can be made a worthy competitor of other known means for accomplishing

Table IV—Performance of the No. 10 Elesco Exhaust Steam Injector

(Delivery pressure, 190 lb. gage; supplementary pressure, 175 lb. gage; bore of supplementary nozzle, 9 mm.; dry overflow.)

1	2	3	4	5	6	7	8	9	10	11	12	13
Exhaust pressure, lb. gage	H_e B.t.u.	t_s deg. F.	t deg. F.	W max. lb. per hr.	W min. lb. per hr.	S_e lb. per hr.	Wt max. lb. per hr.	Wt min. lb. per hr.	m %	Q_e B.t.u. per hr.	Q_s B.t.u. per hr.	n %
1	1151	50	142	26,200		1300	27,500		4.73	1,608,437	35,700,000	4.53
1	1151	50	222		13,000	1225		14,225	8.62	1,609,437	18,500,000	8.70
5	1157	50	152	26,900		1625	28,525		5.71	2,010,737	37,000,000	5.44
5	1157	50	232		13,700	1500		15,200	9.88	1,935,937	19,600,000	9.88
10	1160	50	162	27,500		1970	29,470		6.68	2,418,937	38,220,000	6.32
10	1160	50	232		15,000	1730		16,730	10.35	2,219,037	21,750,000	10.29
15	1163	50	174	28,800		2445	31,245		7.83	3,001,637	40,600,000	7.40
15	1163	50	232		17,700	2270		19,970	11.38	2,817,937	25,950,000	10.85
20	1164	50	198	26,500		2875	29,375		9.80	3,405,947	38,150,000	9.20
20	1164	50	228		20,400	2655		23,055	11.50	3,291,137	30,000,000	10.97
1	1151	60	152	25,500		1253	26,753		4.69	1,566,117	34,730,000	4.51
1	1151	60	228		12,800	1141		13,941	8.19	1,512,517	18,105,000	8.35
5	1157	60	162	26,000		1558	27,558		5.66	2,208,977	35,795,000	6.16
5	1157	60	230		14,700	1494		16,199	9.25	2,017,937	21,010,000	9.60
10	1160	60	173	27,600		2035	29,635		6.86	2,496,437	38,500,000	6.48
10	1160	60	230		17,200	1940		19,140	10.14	2,525,937	24,850,000	10.15
15	1163	60	189	26,800		2390	29,190		8.20	2,928,437	37,910,000	7.74
15	1163	60	232		18,900	2277		21,177	10.75	2,848,737	27,450,000	10.37
20	1164	60	210	25,600		2829	28,429		9.94	3,465,937	36,990,000	9.60
20	1164	60	232		21,100	2671		23,771	11.24	3,305,957	30,820,000	10.73
1	1151	70	163	24,900		1240	26,140		4.75	1,554,137	34,110,000	4.56
1	1151	70	228		13,700	1155		14,855	7.78	1,533,937	19,300,000	7.95
5	1157	70	174	25,700		1595	27,295		5.83	1,984,237	35,599,000	5.58
5	1157	70	232		15,900	1584		17,484	9.08	2,034,737	22,690,000	8.94
10	1160	70	184	26,800		1990	28,790		6.92	2,449,937	37,398,000	6.56
10	1160	70	230		18,200	1928		20,128	9.56	2,429,937	26,150,000	9.30
15	1163	70	200	26,600		2418	29,018		8.33	2,982,937	37,650,000	7.66
15	1163	70	230		19,600	2145		21,745	9.88	2,700,937	28,250,000	9.56
18	1164	70	210	26,100		2636	28,736		9.17	3,240,537	37,310,000	8.79
18	1164	70	230		21,600	2480		24,080	10.39	3,090,437	31,250,000	9.89
1	1151	80	180	23,600		1302	24,902		5.23	1,649,437	32,350,000	5.10
1	1151	80	223		15,200	1162		16,362	7.11	1,529,437	19,750,000	7.74
5	1157	80	187	24,700		1589	26,289		6.04	1,996,537	34,150,000	5.85
5	1157	80	222		18,000	1546		19,546	7.95	1,982,347	25,400,000	7.80
10	1160	80	202	24,800		1995	26,795		7.45	2,474,837	34,950,000	7.08
10	1160	80	227		19,800	1923		21,723	8.85	2,485,437	28,200,000	8.83
15	1163	80	214	26,300		2515	28,815		8.73	3,114,387	37,450,000	8.40
15	1163	80	228		22,300	2322		24,622	9.43	2,893,337	32,020,000	9.03
19	1164	80	230	24,400		2695	27,095		9.95	3,329,937	35,190,000	9.47
19	1164	80	230		23,600	2572		26,172	9.84	3,187,937	33,990,000	9.38

the preheating of feedwater by exhaust steam on locomotives.

Inasmuch as the curves in Fig. 10 prove that with rising exhaust-steam pressures the exhaust-steam injector can feed increasing quantities of water, and inasmuch as during the operation of the locomotive rising exhaust pressures indicate increased water requirements, the pumping and feedwater-heating properties of these machines adjust themselves rather well to the operating conditions of a locomotive. Generally speaking, the feedwater-heating effect that can be obtained increases with the size of the injector with which the boiler can be conveniently fed.

The larger the size of injector which can be selected the lower are the ratios of water to steam with which it operates, also the smaller is its pumping ability and the smaller its reserve of power in pumping against a given boiler pressure. In practice it will be desirable to select the size of an exhaust-steam injector so that positive operation and sufficient flexibility are assured with the suction-water temperatures that are encountered, but to select an unnecessarily small injector or one that is used near the higher limit of its stability range means a wanton sacrifice of feedwater-heating capacity.

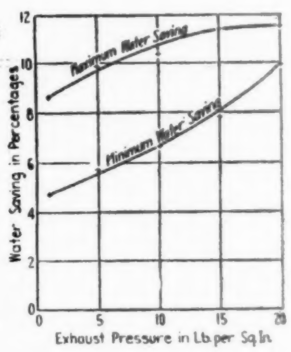


Fig. 11—50 deg. F.

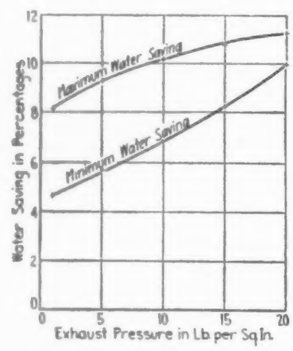


Fig. 12—60 deg. F.

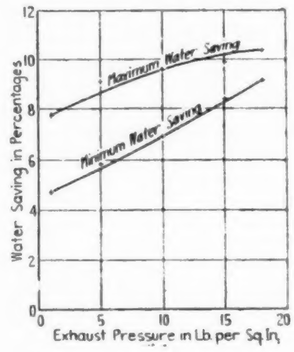


Fig. 13—70 deg. F.

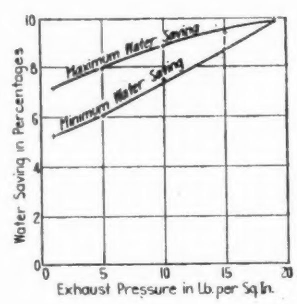


Fig. 14—80 deg. F.

Charts showing the water saving as a function of exhaust pressure for four suction-water temperatures.

If auxiliary automatic means for preventing undue exhaust-steam pressure fluctuations are added to the Elesco exhaust-steam injector, it will be benefitted just as a compound injector, a fact which has been referred to, though automatic exhaust-steam pressure regulation is of smaller practical consequence to the working of injectors which, like the Metcalfe-Elesco combination, have an inherently greater range of stability than to the working of compound injectors. Still, by adding the mechanical complication of a pressure-regulating or limiting device to the former, relatively larger sizes of injectors become possible and greater feedwater effects are secured. It even seems quite within the possibilities of design to evolve automatic exhaust-pressure limiting means so constructed that exhaust pressures are limited to higher and higher values as the quantity of water handled by an Elesco injector is increased. In that manner they could be made to work with minimum or near minimum ratios of water to steam over the entire range of water quantities and exhaust-steam pressures which might be encountered, with greatest feedwater-heating effect and a sufficient stability of the jet. If it is found possible to design such regulating means so skillfully that the maintenance cost of the entire injector installation is not materially increased or that the operation of the injector is not accidentally endangered, the use of exhaust-steam injectors would produce fuel and water savings which are consistently near the values indicated in the upper curves of Figs 11 and 15.

Discussion by T. C. McBride

T. C. McBride, consulting engineer, railroad department, Worthington Pump & Machinery Corporation, Philadelphia, Pa., presented a written discussion of Mr. Osterman's paper, of which the following is an abstract:

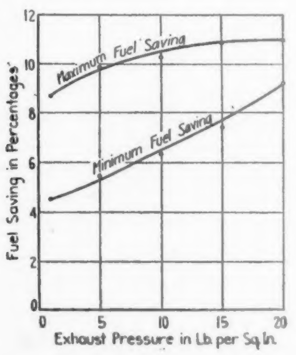


Fig. 15—50 deg. F.

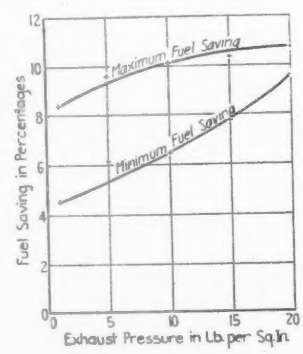


Fig. 16—60 deg. F.

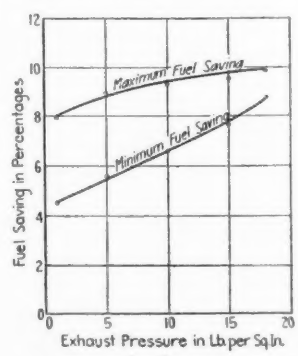


Fig. 17—70 deg. F.

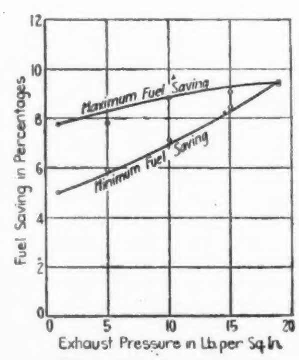


Fig. 18—80 deg. F.

Charts showing the fuel saving as a function of exhaust pressure for four suction-water temperatures.

It is unfortunate that the boiler pressure selected for the tests described in Mr. Osterman's paper is lower than the boiler pressures usual in locomotives in this country, and that the different pressures selected for the tests have not been arranged in the relationship they bear to each other on the locomotive. Good mechanical and other details in design may be taken for granted, but beyond these details, the user is interested in the heat recovery and the capacity range of the exhaust-

steam injector. The heat recovery determines the fuel saving or increased steaming capacity that may be obtained from the injector. The range in capacity throughout which the injector will operate and feed the boiler, determines the convenience of operation.

These tests are reported in Table IV and were evidently conducted in the laboratory with 190 lb. boiler pressure and 190 lb. injector delivery pressure. However, 190 lb. injector delivery pressure could feed a boiler of only 180 lb. steam pressure and the tests must be considered as applying to this steam pressure if they are to be considered as applying to operation on a locomotive. As rearranged to suit actual locomotive conditions, the injector delivery pressure would be 190 lb., the boiler pressure 180 lb., the supplementary steam pressure 175 lb. and the feedwater heating effect should be recalculated on the basis of 180 lb. steam pressure in the boiler. This rearrangement will not seriously affect the results already calculated, but it is important that it be understood that the tests as conducted in the laboratory, if considered as applying to an exhaust-steam injector in service on a locomotive, must apply to a boiler pressure of 180 lb. This is particularly important if the test results reported are to be used to form an idea of the operating characteristics of the exhaust steam injector on our locomotives with their higher boiler pressures.

With all exhaust-steam injectors, and like feedwater heating arrangements, other things being equal, the heat recovery and the capacity range are reciprocal. The extent of one must be sacrificed in order that the other may be increased.

This characteristic of the exhaust-steam injector can best be understood by reference to the Metcalf exhaust-steam injector as used in England and of which the injector described in the paper is a modification. In the Metcalf exhaust-steam injector, the amount of live steam is regulated by hand. If the amount of live steam is increased—of course, within limits—the capacity range is increased and the injector can be cut down or opened up to meet the lighter or heavier water requirements of the boiler. But the increased amount of live steam results in less exhaust steam condensed, less heat recovered and less fuel saved. Here fuel saving has been sacrificed to obtain a wider capacity range and greater convenience of operation. If, on the other hand, the amount of live steam is reduced, the heat recovery and fuel saving are increased, but at the expense of a reduction in capacity range. Here higher fuel saving has been obtained, but at the expense of trouble in operation because of limited capacity range. Finally it will be found that there is one certain capacity at which a minimum amount of live steam secures operation. The heat recovery and fuel saving are then at their maximum, but the injector will operate at only this one particular capacity, and this particular capacity can only by chance equal the water requirement of the boiler. This is the real problem of the exhaust-steam injector. Some compromise must be reached as between fuel saving and convenience of operation and the locomotive engineman is likely to favor convenience at the sacrifice of fuel saving.

All of this leads up to the Metcalf-Elesco exhaust-steam injector, described in the paper with its fixed amount of live steam, which in the test reported was 910 lb. per hour. The operation of the injector has been simplified by the omission of one valve, but at the expense of a compromised combination of a fair capacity range and a fair saving in fuel. The locomotive engineman cannot increase the amount of live steam if he needs still less water for the lighter working of the locomotive, or still more water for the heavy working of the locomotive. Neither can he reduce the amount of live steam and obtain a still greater saving in fuel when the injector is working at a capacity which would otherwise permit operation with this greater saving.

The user of the exhaust steam injector is vitally interested to know the capacities at which it will work, and the heat and fuel saving that can be obtained from it within the range of this capacity, but little has been said in the paper of the relation between these two features. Now that the information of Table IV is available, this relation can be studied. The heat recovered and the maximum and minimum capacities for 1, 5, 10, 15 and 20 lb. exhaust-steam pressure have been plotted with the two points for each exhaust pressure connected by a solid line marked with that exhaust pressure (Fig. 19). The dotted curved lines then indicate the area throughout which the injector operated in the laboratory. Dotted lines have been drawn across this area to average the test results and indicate each pound exhaust pressure from 1 to 20. This is as far

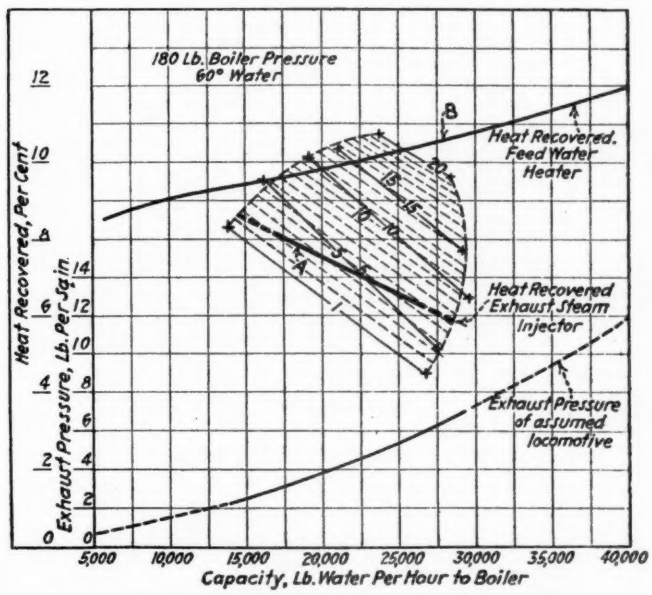


Fig. 19—Pumping capacity as a function of heat recovered and available exhaust-steam pressure

as the laboratory tests can go, but it is noted that the capacity range is reduced with high heat recovery and increased with low heat recovery.

With this laboratory information available, it is possible to determine what will happen when the exhaust-steam injector is applied to a locomotive, and the question immediately arises as to how large the injector should be in relation to the steaming capacity of the locomotive. It has been presumed that an exhaust-steam injector would be selected of such a size that its maximum capacity would be about 75 per cent of the 100 per cent boiler capacity as determined by the Cole system of ratios. Since the maximum capacity of the exhaust-steam injector tested is about 30,000 lb., it has been presumed that the proper size boiler for it would be one having 40,000 lb. evaporation as determined by the Cole ratio method. With this thought in view, the curve marked "Exhaust pressure of assumed locomotive" (Fig. 19) has been plotted from records of an existing locomotive. Only the exhaust pressures of this curve are available for operation of the exhaust-steam injector on this locomotive. When these actual

exhaust pressures for each capacity are extended vertically to their intersection with the dotted line representing the same exhaust pressure in the laboratory test, it is found that this exhaust injector, operating on this locomotive, will operate along the lower line. This line, therefore, determines the maximum and minimum capacity at which the exhaust-steam injector can work when installed on this particular locomotive, and the amount of heat it will recover when working at any point between these two capacities.

Of course, the capacity of the injector can be increased or decreased in case of high or low water in the boiler, provided the new capacity is within the limits defined by the curved dotted lines. In this case, the line *A* represents the average condition and any departure from it is along the dotted line indicating the exhaust steam pressure supplied by the locomotive at the time.

In the paper, it is stated that exhaust-steam injectors on locomotives must work with exhaust pressure as low as 1 lb. In Fig. 19 it is noted that the locomotive requires about 7,500 lb. of water per hour when the exhaust pressure is 1 lb., but that the minimum capacity of the injector with this exhaust pressure is 14,000 lb. per hour. In order to make use of 1-lb. exhaust pressure, this injector would have to be stopped and started, and in service but half the time.

The exhaust-steam injector will not operate on this particular locomotive with less than 2½-lb. back pressure and would then recover 8.8 per cent heat. It could doubtless be made to operate at a lower exhaust pressure and lower capacity, if supplied with a larger live-steam nozzle and more live steam than the 910 lb. used in the test, but then the heat recovery would be reduced. Similarly, the high heat recoveries of the laboratory test with high exhaust pressures cannot be obtained from the exhaust-steam injector installed on this locomotive. The locomotive supplies an exhaust pressure of only 6.8 lb. at the maximum capacity at which the injector will work and the heat recovery is then only 5.9 per cent.

Other features must be considered when using the laboratory test to determine the action of the exhaust-steam injector in operation on a particular locomotive. If it is presumed that the exhaust pressure of the locomotive may fluctuate to as much as 3 lb. higher than the average shown by the curve at the minimum capacity and 3 lb. lower at the maximum capacity, then the minimum capacity will be increased to 16,250 lb. of water per hour, and the maximum will be reduced to 27,500 lb. per hour, instead of the minimum of 14,500 lb. and the maximum of 28,250 lb. of the laboratory test. Furthermore, it will not be possible to start the injector at either extreme of its capacity, but only at some small distance within the operating area, and the quality of the steam supplied by the locomotive will not be as good as that of the steam in the laboratory. For these reasons, satisfactory operation of the exhaust-steam injector at capacities approaching either end of the lower line is doubtful, and it is for this reason that the ends of this line have been shown dotted.

The author of the paper advocates the use of a large size of exhaust-steam injector in proportion to the size of the locomotive. The effect is evident from an inspection of Fig. 19 for the relatively larger size exhaust injector will then be supplied with a higher pressure of exhaust steam, and there will be a higher heat recovery and greater fuel saving, but here again this greater fuel saving is obtained at the expense of a reduced capacity range and less convenience of operation, for the area throughout which the injector will operate narrows toward the top.

The amount of water required by a locomotive at its usual working rates on the road, determines the size of the exhaust-steam injector best suited for it, not the heat recovery possibilities of other sizes of injectors.

The author also comments on the advisability of an exhaust-pressure-limiting device added to the injector. From Fig. 19, it is evident that the locomotive itself is such a limiting device. In the case of locomotives with much higher back pressures, such a limiting device might have some effect and hold lower line down toward the bottom of the operating area of Fig. 19, but any such arrangement would be a deliberate sacrifice of heat recovery and fuel saving in order to obtain a greater capacity range, and more convenient operation.

The author also reaches the conclusion that the exhaust-steam injector "can be made a worthy competitor of other known means for accomplishing the preheating of feedwater by exhaust steam on locomotives." This conclusion may seem warranted from the standpoint of the laboratory test, but when the exhaust-steam injector must operate under the limitations imposed by the locomotive, as shown by Fig. 19, the conclusion must be quite different. The curve *B*, marked "Heat recovered, feedwater heater" has been added to Fig. 19, to show exactly the comparison between the feedwater heater and the exhaust-steam injector when operating on the same locomotive, under the same set of conditions.

Feedwater heaters are now generally applied to locomotives of a capacity large enough to supply the boiler up to its 100 per cent capacity. Exhaust-steam injectors large enough to supply the boiler at its higher working rates would not be practicable because they would then be so large that they would not supply the boiler at its more usual working rates on the road, except by intermittent operation. It is noted that the feedwater heater recovers most heat at the higher working rates of the locomotive and, therefore, increases the capacity of the locomotive because it increases the maximum steaming capacity of the boiler. The exhaust-steam injector must be helped out by the other injector when the boiler is suffering for capacity, and it increases the steaming capacity only for its share of the feeding. The exhaust-steam injector can increase the capacity of the locomotive to about one third the increase obtained from the feedwater heater.

The relation of the heat recovered and the possibilities of fuel saving within the limits of operating capacity of the exhaust-steam injector is definitely shown on Fig. 19.

All of the values of Fig. 19 are based on the presumption of 180 lb. boiler pressure of the laboratory test as conducted. These values will be quite different for American locomotives because an injector delivery pressure of 210 to 260 lb. will be required. With these higher pressures, the operating area of Fig. 19 will be narrower if the same proportion of live and exhaust steam is maintained. In order to obtain a sufficiently wide range of capacity of the exhaust-steam injector, it will be necessary to use a larger live-steam nozzle, and greater proportion of live steam with consequently lower heat recovery and fuel saving.

Comment has frequently been made on the extensive use of the exhaust steam injector in England, but it should be remembered that 180 lb. is the usual boiler pressure in England with but a small portion of their locomotives carrying any higher pressure. The higher pressures carried by our locomotives present quite a different problem. In fact, it has been generally understood that 180 to 190 lb. boiler pressure is the limiting

pressure for the exhaust-steam injector and that for pressures beyond these, the feedwater heater must be used.

Other Discussion

C. T. Ripley, chief mechanical engineer, Atchison, Topeka & Santa Fe, speaking from the user's viewpoint, said that there is a real need for the development of the exhaust-steam injector. There are two principal factors in which the railroads are interested; namely, the exhaust-steam injector is considerably lighter than feedwater-heater equipment, and undoubtedly it will be cheaper to maintain. He questioned whether the difference between the fuel saving of the feedwater heater and exhaust-steam injector would be more than made up by the cost of maintenance. Labor, he said, is rising in price faster than fuel, which, of course, does not interest the manufacturer as much as it does the railroads. Mr. Ripley also compared the operation of exhaust-steam injectors on locomotives operating in Great Britain to those operating in this country. The railroads in Great Britain operate over a more level territory at more uniform speeds, less slow downs, less stops and less drifting. This is distinctly in favor of the exhaust-steam injector. However, the majority of the tests made in this country, he pointed out, have been made with only one or two of these devices. This, in a way, is unfair to the device. If a whole division were equipped, the fireman would become more familiar with the operation of the exhaust-steam injector, which is particularly necessary in the case of the cooling of engines, a practice which exists on most of the western roads. From the standpoint of the railroads he said that he would like to see more data developed as to possible results with the exhaust-steam injector.

In his closing remarks, Mr. Osterman stated that he did not have in mind a direct comparison between the characteristics of injectors and pump feedwater heaters. The object of his paper was to give a descriptive analysis of the phenomenon to determine the possibilities and limitations of injectors. He referred to the statement made in his paper to the effect that he considered the characteristics of the injector lent themselves to the feeding of locomotive boilers because the back pressure increases and the feeding capacity of the injector increases as the water requirements of the locomotive increase.

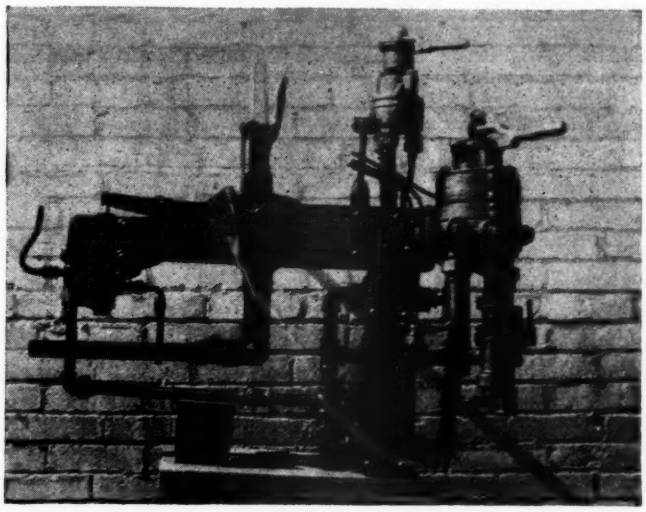
Replying to Mr. McBride's criticism that higher boiler pressures were not used in the analysis, Mr. Osterman stated that there are many locomotives operating at pressures from 180 to 200 lb. and the test results given in his paper, which were figured at 190 lb. pressure, should give a fair idea of the possibilities of the exhaust-steam injector. He referred to one injector installed on a locomotive operating at 250 lb. pressure, which operates satisfactorily. The amount of live steam used, he said, has a greater effect on the range of the injector than it has on the fuel-saving capacity. It effects the fuel-saving capacity only in so far as it is not possible to decrease the ratio of water to steam beyond a certain amount for fear of the injector breaking. In other words, the exhaust-steam injector is limited to certain delivery temperatures, depending on the amount of loading that is given the overflow valve. With higher boiler pressures, the overflow valves are automatically loaded to a higher overflow pressure, which is of considerable assistance toward increasing the range in higher pressures.

Valve Bracket Saves Space in the Cab

By J. D. Flinner

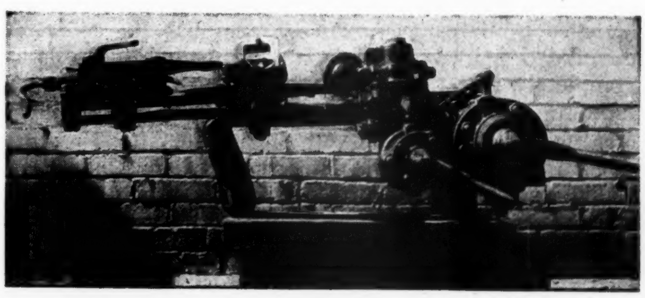
Supervisor of Air Brakes, Monongahela, South Brownsville, Pa.

THE bracket shown in the two illustrations is designed to save space in the cab of a locomotive and also to reduce the amount of piping. Provision is made for holding the brake valve, feed valves and the



Side view of the bracket, showing the location of the different valves and the power reverse lever

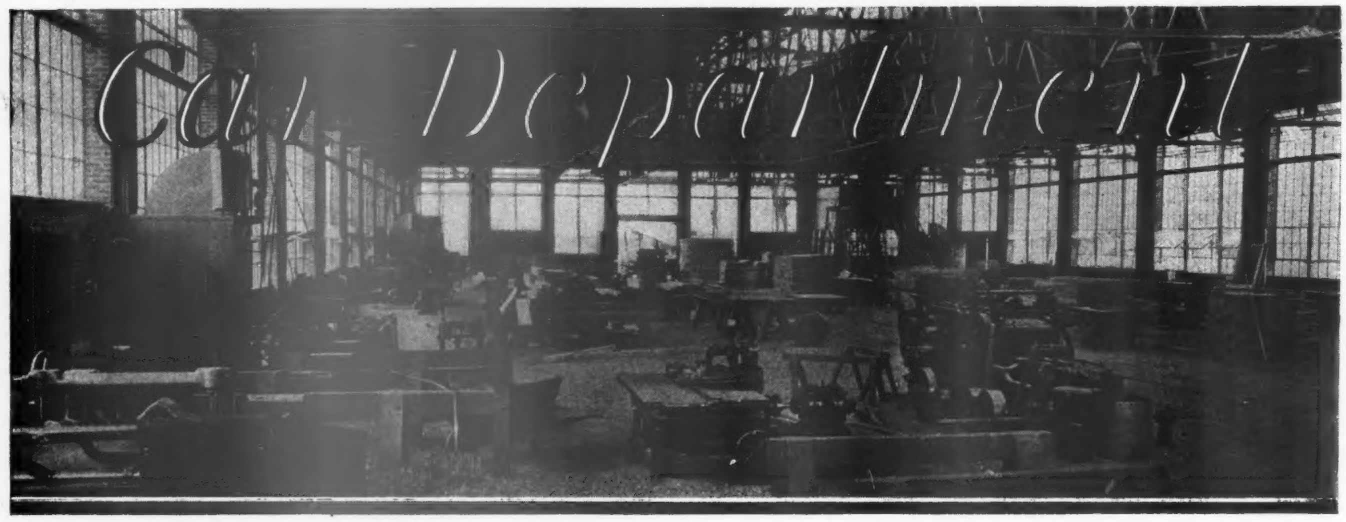
power reverse lever and reverse-lever pilot valve on locomotives equipped with the Franklin booster. The bracket is secured to the backhead of the boiler by four studs. It can be easily removed by removing the nuts



Top view of the assembled bracket, valves and power reverse lever

from these studs and disconnecting the pipe unions. The design is standard for all locomotives on the Monongahela and can be removed from one locomotive and applied to another of the same class. At the present time, the Monongahela has 16 locomotives equipped with this bracket and others are being equipped as they go through the backshop for repairs.

REAMERS.—The Foster-Johnson Reamer Company, Elkhart, Ind., illustrates in a 48-page brochure F-J reamers of the expanding type for hand operation only.



Milwaukee Passenger-Car Shop Work Reorganized

Complete change in policies and methods of handling shop operations contribute to increased efficiency and economy

IN the summer of 1927, the management of the Chicago, Milwaukee, St. Paul & Pacific decided to curtail passenger-car repair expenses sharply. Inasmuch as the Milwaukee coach repair shop then, as now, spent the major portion of the money appropriated by the road for passenger-car repairs, it naturally was forced to bear the largest part of the burden in this particular cost reduction. Furthermore, the management was anxious for the curtailment of expenses to commence immediately. To accomplish the economies demanded, Milwaukee shop was compelled to reorganize completely and to change its policies and methods of handling shop work. This was accomplished quickly and, within a comparatively short time, the shop was operating in a new and more progressive manner.

The fact that the policies and methods adopted and since followed are sound is indicated by the results obtained during the first year of operation. The total passenger-car repair expense was reduced 38 per cent, compared with the expenditure of the shops during the previous fiscal year. Also, although this shop during the year spent only 62 per cent of the road's total expenditure for passenger-car repairs, it made 76 per cent of the road's savings, or 14 per cent more than its theoretical share. The average cost per car turned out was reduced 59 per cent, the car output was increased 88 per cent, and the labor force decreased 17 per cent compared with the previous year. The reduced car costs and increased car output were not obtained by any neglect in the repairs made to cars, as clearly shown by these two facts: First, passenger train delays caused by equipment failures were decreased from 645 to 536, or over 11 per cent during the year, and hot boxes were reduced from 274 to 242, or over 15 per cent., Second, the shops did not place any extra burden upon the terminals and road points, inasmuch as the latter were able to reduce their passenger-car expenses 24 per cent.

Additional results obtained at the Milwaukee passenger-car shops may be mentioned as follows: The greatest output of repaired cars in the history of the shop was obtained in August, 1927, when 103 cars were turned out. Also the greatest average daily output was obtained in September, 1927, when 4.13 cars per day left the shop. August and September, 1927, were the first months in which an average daily output of four repaired cars was obtained.

From August, 1927, to August 1, 1928, 50 rebuilt cars were turned out at an average cost of over $10,000 per car. This means that practically one rebuilt car left the shop each week. Also, during the year, 843 general-repair cars, 66 light-repair cars, and 50 rebuilt cars, or a total of 959 credit cars, were turned out. This means that a repaired car left the shop every two hours and 20 minutes of each working day. In addition, 118 other cars left the shop during the year.

In the matter of car costs compared with car output, the general-repair cars contributed 88 per cent of the total car output and cost 67 per cent of the total repair expense. Rebuilt cars contributed 5 per cent of the output and cost 31 per cent of the total repair expense, while light-repair credit cars contributed 7 per cent of the output and cost 2 per cent.

Of the total cost of repairs made to the 959 credit cars turned out, 75 per cent of the expense was incurred for repairs in kind, which includes alterations, 24 per cent for addition and betterment work, and one per cent for repairs caused by wrecks and fire damage.

The labor force in the passenger department was re-

duced from an average of 1,011 men to 842, or 16.7 per cent. The repair force, while smaller, has enjoyed steady employment, the shops being in continuous operation every working day during the past 15 months, with the exception of a close-down for two half days in December, 1927.

New Policies and Methods Adopted

Under the former shop organization, duties and responsibilities were in many cases not clearly defined. Furthermore, in some cases the supervisors covered such a large field that close supervision was impossible. To overcome these conditions, the entire shop force was reorganized in August, 1927, this reorganization taking place along four main lines. First, several shop departments, such as the truck shop, wood mill, air-brake shop and machine shop, that performed passenger-car repair work but were separate from the passenger department, were brought under the jurisdiction of that department. Second, various shop departments were split up into two or more separate departments. Third, the work assigned to be handled by each department was such work as logically and naturally belonged to it. Fourth, a foreman was designated to be in charge of each of the three coach shops, each of these foremen being responsible for the car output, and the behavior of his shop.

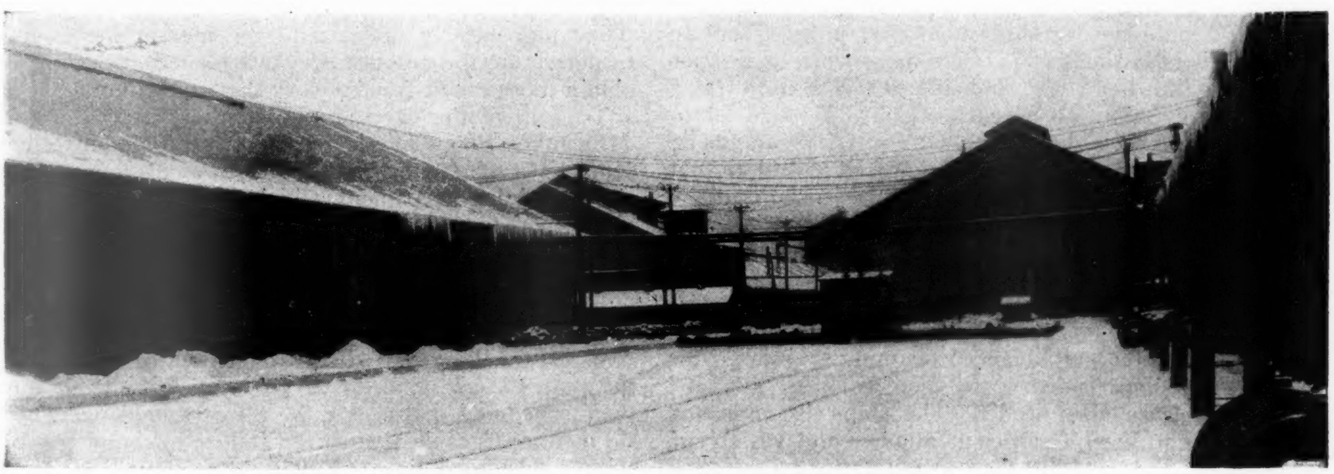
The chart in one of the illustrations shows the present shop organization, under which duties are clearly defined, responsibility firmly fixed, and supervision more intense. It will be noted, for example, that during the time jackers, electricians, air-brake men, etc., are in any shop, they report to the foreman of that shop as well as to their own foreman. The erecting shop indicated on the chart is in reality a second large coach shop, in one end of which repair and painting operations are carried on. The center of this shop is devoted to truck repairs and the other end to machine-shop work.

The station-to-station plan of routing cars through the shop was installed. Formerly a car stayed in one stall from the time it entered the shop until it left. Under the new plan a car entering the shop is spotted on the wash tracks where it is stripped of loose equipment and washed. The car is then moved to one of the repair shops for repairs and painting. From there the car is moved to the trimming tracks for completion. Under this system four main results are obtainable. First, work is segregated with the resultant economies. Second, responsibility is firmly placed upon each station and upon each auxiliary department supplying the station with material or car parts, to perform its work properly and on time. Third, there is better supervision over the shopmen. Fourth, under the urge of friendly competition between stations, work is speeded up.

The repairs made to passenger cars are limited, in general, to repairs in kind; that is, alteration work is minimized. Furthermore, supervisors are prohibited from making any extra-heavy repairs in kind, or any alterations to any car without specific authority from the general foreman. This procedure is necessary not only as an economy measure, but to prevent any conflict with the passenger-car retirement program. It must not be construed, however, from the foregoing that the car repair work at Milwaukee shops is strictly confined to repairs in kind. During the fiscal year 1927-28, 13 per cent of the cars turned out of shops received additions and betterments that cost 24 per cent of the total money spent on all cars turned out of shop.

The use of new material on cars is reduced to a minimum, this being accomplished by reclamation and conservation. Large quantities of various material, such as brake beams, truck pedestals, etc., are reclaimed with a resultant saving over the cost of purchasing such materials new. Again, material that is serviceable is retained in service, and a definite effort is made to keep it out of the scrap bins. The utilizing of reclaimed material and the retention of serviceable material enabled the shop to reduce the material proportion of the car-repair-cost dollar from 34.4 cents during the previous year to 25.8 cents during the year 1927-28. The total material charged to cars turned out of shop during the year 1927-28 was 42 per cent less than in 1926-27.

The installation and use of many new tools and modern machinery enabled the cost to be cut on many operations. For example, a few months ago a hydraulic press, glue spreader, belt sander, taping machine, jointer and drum sander were installed in the cabinet shop. As described in the January *Railway Mechanical Engineer,* these machines saved about $7,500 (the approximate cost of the machines) in the handling of sash, and the manufacture of headlining and plywood for 18 rebuilt suburban cars alone. Another example was the replacement of hand jacks with air jacks for raising cars, the jacking cost per car being reduced about $8. In addition to the new and modern tools and machinery, many short-cut methods of performing the work have been installed. An example is afforded in the use of a lift truck and portable sash racks which



Winter scene at the Milwaukee passenger car shops of the C. M. St. P. & P.

will be described more in detail later in this article. In addition, tractors of several varieties are used for hauling and lifting all kinds of material. They are used to lift drawbars into position on cars, raise stoves from the ground to the floor of the car, etc.

Shop Work Kept Well Balanced

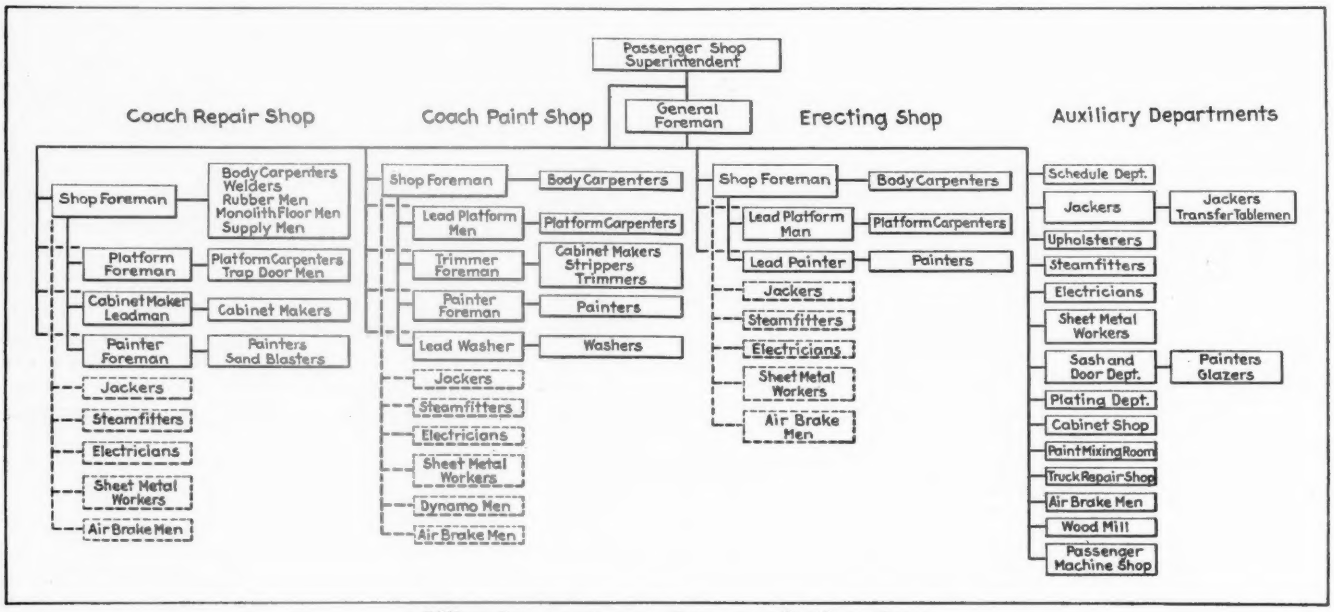
Prior to August 1, 1927, the general repairs to passenger-train cars were made at seven shops on the system. After that date, passenger repair work was concentrated at Milwaukee with the exception of the repair work for a few special cars such as miner's coaches. This concentration of work placed Milwaukee Shops in a position of not only having a greater supply of cars available for shopping, but made it possible for the shops to obtain a well-balanced supply of work, and to have a greater variety of cars in the shop. In addition to other economic advantages incident to concentration, the location of Milwaukee in the center of the passenger traffic movement permitted back haul to be minimized.

Every effort is made to keep the shops well balanced with car work. Inasmuch as the car ownership is in the general ratio of two head-end cars, two coaches and one high-class car (sleeper, diner, parlor, etc.), the labor force of the shops is apportioned and specialized to handle car work in about that proportion. In general there is about 25 per cent more work on a coach than on a head-end car, and 200 per cent more on a high-class car than on a coach. The difference in the amount of work is due to the car's interior equipment.

To operate efficiently, therefore, it is essential that the proper ratio and number of cars be in shop undergoing repairs at all times. However, when traffic demands are such that certain classes of cars cannot be released for shops, the shops are compelled to obtain other work to counterbalance the deficiency, or suffer an economic loss. To guard against an unbalanced shop, anticipation and advanced planning is resorted to; that is, the shops endeavor to keep work in "storage" for quick release when needed. The shops also endeavor at all times to keep a sufficient number and variety of cars in the yard awaiting shop so as to afford a selection of the cars that are to enter the shop each day. To assist the transportation department in releasing cars for shopping, the shops issue a "shopping schedule" which lists the individual cars that are to be sent to the shops each month. The shopping cycle is set at 18 months.

To eliminate car-output measurements of doubtful correctness and to establish repair classifications that are correct and easily understood by everyone, the car-repair classifications were changed. "Heavy Repair" and "Medium Repair" are now simply "General Repair." A car that receives structural or car-class changes while being shopped is classed as a "Rebuilt Car." For example, the application of a steel underframe and steel plating to a wooden car, or the conversion of a compartment sleeper to a club car, is considered rebuilding work. The classification "Light Repair" is modified to distinguish between output-credit cars and non-credit cars. The shops now obtain output credit for turning out a light repair car when the cost of the repairs made to it exceeds $100. Formerly no credit was obtained for a light-repair car even though the cost of the repairs made to it may have equalled or exceeded the cost of the repairs made to a general repair car. This simplified repair classification, and the allowing of output credit for light-repair cars when the work performed on them is sufficiently heavy, has had a good psychological effect upon the shop employees. They now clearly understand the measurements used to determine the amount of work turned out, and they obtain more credit for the work they do turn out.

To control the car output and the car-repair costs, Milwaukee Shops has in operation several control systems. These systems, explained below, are operated by the schedule department which consists of two men who report to the passenger shop superintendent.



Milwaukee passenger shop organization chart

Output Controlled by Schedule System

The passenger-car output is controlled by a scheduling system which, while simple, has proved to be very effective. Of the 987 repaired cars turned out of shop during the year 1927-28, 898, or 91 per cent, left the shop on their scheduled dates. Of the 89 cars held over, only 38 were chargeable against the failure to complete work within scheduled time. Furthermore, only 188, or 19 per cent, of the schedules had to be reset while the cars

were undergoing repairs. This changing of schedule dates was due to the discovery of hidden defects while the repair work was progressing, to accommodate the transportation department, to re-establish a balanced shop, and to provide a smooth shop operation.

To insure a smooth shop operation, the car-output quota is set for each week. At present the quota is three cars per day, or 17 cars for a 5½-day week. During the year 1927-28, the car output and quota were exactly the same for 26 weeks. During three weeks the output was below the quota. During 14 weeks, the output exceeded the quota by one car; for five weeks by two cars; for four weeks by three cars, and in one week four more were turned out than the quota demanded, therefore, the quota was met or exceeded during 50 of the 53 weeks. Furthermore, on only one working day of the year was there a failure to turn out any cars. On no day was more than six cars turned out, and this number only occurred five times. On 135, or 44 per cent of the 305 working days of the year, three cars were turned out each day. It is evident from the foregoing that there was no "bunching up" in the turning out of the cars, and that the shops operated smoothy from day to day, week to week, and of course, month to month. During the year an average daily output of 3.42 cars was obtained against a quota demand of 3.19 cars.

Built-up schedules are used to control the car work progressing through the shop. Each car is treated individually and the schedule is drawn up to fit the repair work to be done on it. In setting the schedule dates, consideration is also given to such factors as shop conditions, output to be obtained, etc. The schedule completion dates for operations and the out-date for the cars are not set until the car has been shifted from the stripping station to the repair station. This lapse of time is granted for various reasons some of which are: To permit the inspection of the car by the repair-shop supervisors; to obtain the necessary shop orders when additions and betterments are to be made; to permit the ordering of material in advance, and to allow the scheduleman the opportunity of pushing one car ahead

Individual Car-Cost Statement for Steel Passenger Coach

Name	Labor	Material	Credit	Total
1. Truck	$88.80	$6.95	$ .55	$95.20
2. Jacking	17.72			17.72
3. Washing	40.56			40.56
4. Upholstering	52.63	40.07		92.70
5. Sheet metal	36.02	3.32	.24	39.10
6. Plating	13.40	.43		13.83
7. Mill cabinet	57.75	6.75		64.50
8. Sash doors	68.52	4.26		72.78
9. Machine	3.03			3.03
10. Blacksmith	15.44	2.00		17.44
11. Wood mill	8.77			8.77
12. Pattern				
13. Air brake	11.77	8.64		20.41
14. Steam fitting	21.27	6.49		27.76
15. Electrical	6.81	.02		6.83
16. Carpenters	115.33	18.86	3.96	130.23
17. Car cabinet		.46		.46
18. Platform	27.00			27.00
19. Painting	173.01	52.01		225.02
20. Trimming	105.58			105.58
21. Car-repair men				
22. Machine, freight				
23. General passenger repair	115.92			115.92
24. Shop orders				
25. Shop expense	182.96			182.96
27. Total	1,162.29	163.78	4.75	1,321.32
26. Store expense		13.52		13.52

of another, if it is deemed necessary, for example, to protect the car output.

After a car has been shifted from the stripping station to the repair station, the scheduleman, in consultation with the general foreman, immediately sets the start and completion dates for the various operations, the date for moving the car to the trimming station, and the date when the car is to leave the shop. This scheduling of work is done for both general and light-repair cars. In cases where cars require extremely heavy repairs, they are oftentimes considered "balancers," and the scheduling of the operations is deferred until the repair work has reached the point where the scheduling of the operations will impose no extreme hardships upon any shop department. The work on these "balancers" is performed by the departments most affected, with the surplus of men they may have from time to time when

Raising one end of a steel car with modern air-operated jacks

work on ordinary repair cars becomes lighter. By pursuing this policy, the "balancers" are not only turned out of shop within a reasonable time, but the work on other cars is not interfered with by any temporary overloading of certain departments with work, and thus not only causing them to break down, but to delay every other shop department. Furthermore, the shops have waged a fairly successful fight against persons and departments outside of the direct shop management who wish to set the specific date when certain cars must leave shop. This arbitrary setting of dates usually creates inefficiency within the shop.

Another important factor of scheduling is that the schedule must be fast; that is, to obtain the necessary car output, a rapid turnover of cars is required. During the fiscal year 1927-28, general-repair cars averaged only 15.97 working days in shop, rebuilt cars 64 days, making an average of 18.66 days for the 893 cars handled. Light-repair cars, of course, moved faster. Another angle of this fast turnover of cars is that the performance of work is speeded up and the efficiency of the shop thus increased, for the repair work on each car must be done within the scheduled performance time and the number of men available for the work is limited.

Schedule Forms Are Simple

The scheduling forms used at Milwaukee Shops are simple and do not differ greatly from usual forms employed for this purpose. One form is used by the schedule department to show at a glance the cars lined up to leave shop each day and indicate the number of cars obtained and needed to meet the output quota of each week. In addition, the assistant scheduleman hangs on each outgoing car an inspection slip which carries the signature of each department foreman. The

various supervisors after inspecting the completed car in the yard, sign the slip and thus certify that the car left the shop properly repaired and in good serviceable condition.

Cost Control Carefully Watched

Each month the passenger department is allotted a certain sum of money for payroll purposes. To keep this payroll expense within the authorized allotment a simple control system is used. Each day the shop timekeepers furnish the actual amount of the payroll expenditure of each department for the previous day. These figures are totaled and debited to the payroll account. Also the payroll is credited with the daily allotment. Thus the difference between the debit and the credit charges shows the amount the actual expenses are running over or under the allottment. This system enables the shop management to take timely steps, if necessary, to curtail or increase its payroll charges. Over $1,250,000 was controlled by this system during the fiscal year, 1927-28.

Inasmuch as the passenger-car repair expense of the entire road is largely determined by the charges made against that account by Milwaukee Shops, an "Account 317 Control System" is operated. The cost figures for this system are compiled from the shop accountant's daily payroll distribution statement. This system covers only the labor charges made directly to Account 317 (passenger car repairs) and is operated primarily to enable the shop supervisors to watch and regulate their charges. The charges against Account 317 fluctuate from month to month, ranging in amount from 49 per cent of the total payroll to 70 per cent, the difference representing the money charged to other work such as store orders, shop orders, transportation expense, etc. Also the Account 317 charges vary from department to department, ranging from six per cent of the wood mill's payroll to 88 per cent of the washer's payroll, and again these department ratios will vary from month to month. The variations in the amount of the Account 317 charges are principally due to the opportunity and success of the shops in placing their men upon work other than that which necessitates Account 317 charges, as for example, shop-order and store department order work.

To induce the supervisors to keep no more men on Account 317 work than is absolutely necessary, this control system is quite effective. Each department has an objective, which is a fair average allowance for the Account 317 charges that can be made against each car turned out and yet keep the total charges for the shop at a minimum. The actual current charges made by each department divided by the number of cars turned out during that period gives the actual average cost per car. A comparison of the cost and the objective shows whether the Account 317 expenses of a department are normal or not. The total payroll figures of each department, excluding monthly-rated employees, are also obtained to establish the relation between the Account 317 charges and the total payroll. Should conditions be such that the dividing of the charges by the number of cars turned out does not reflect a true condition, the Account 317 expenses can be measured by the expenditure per working day and by its relation to the total payroll.

At least twice a month, and more often if the costs are running high, a statement is issued to all supervisors showing the current condition of the Account 317 expenses. The supervisors call this statement the "stock report," because each department has a "par value" (objective) and a "market value" (actual expense).

The Account 317 Control System does not give the repair cost of the cars turned out of shop, but does show the current expense of passenger car repairs, and indicates whether or not that expense is normal. Over $750,000 was controlled by this system during the fiscal year 1927-28. During the 15 months of operation under this system, the objective of the entire shop was exceeded during only four months and the over-expenditure during these four months was more than offset by the savings during the other 11 months. Also, during

Low-lift truck and platform skid with heavy barrel of soap bound for the washing tracks

the fiscal year 1927-28, while the actual expense for the entire shop per car was $51.98 below the objective, the greatest variation between the objective and the actual expense of any individual department was only $14.71 and the least was 22 cents, indicating a remarkable closeness between the objective costs and the actual costs. In this connection, it is interesting to note that the objectives have not been reset since originally determined.

Control of Individual Car Costs

In February, 1928, an "Individual Car Repair Cost Control System" was installed to control the labor expenditure on each individual car undergoing repairs. The purpose of this system is to keep the repair costs of each car at a reasonable figure and to prevent extraordinarily large repair expenses or unwarranted expenses on any car without proper authority. Second, it keeps the supervisors acquainted with what their expenditures are on each car each day and to the current date, thus furnishing them with important information that has not been available to them in such a manner in recent years.

Each department is allowed a certain amount of labor money for each class of cars, according to the car's length and construction. These standard allowances are based on actual and desired costs, and each supervisor is furnished a statement of the allowances granted. Each day the shop timekeepers draw off from the timeslips the amount of money spent by each department on each car, and enter this amount in the "Today" column of the cost sheet covering the car. The "Today" cost is cumulated from day to day to give the "Total" cost A comparison of the total cost and the standard allow-

ance enables the supervisors and the schedule man to know at all times whether the allowance is being exceeded or not. Shortly after a car leaves the shop, the timekeepers return their cost sheets and enter the totals on a summary report which is distributed to the supervisors for record purposes.

The summary report has a column headed "Transfer Credit" and another "Transfer Debit." Certain shop department are continually loaning and borrowing men among themselves. To avoid inflicting an unwarranted charge against a department that loans men, the loaning department is credited with the money spent by his men on a car while performing work for another department, and the borrower is debited with that amount. Thus, a department with a direct charge of $60 on a car, might be credited with $24, making the net cost of its work only $36. These charges are obtained by having the foreman who borrowed the men so indicate on the men's time slips. The shop timekeepers note these charges on the back of their cost sheet, and the scheduleman makes the proper adjustments when issuing the summary cost sheet.

This system controls the direct labor charge made against the cars in shop. It does not, however, cover general expense or overhead expense. These latter two charges can always be closely estimated inasmuch as they are computed at a certain percentage of the direct car cost. Shop-order charges on cars, that is, the addition-and-betterment work, is also covered by this control system, as are also the light repair cars. Obviously, the shop orders and light-repair cars are not covered by standard allowances. The actual cost figures, however, are obtained in the same manner as for general repair cars. Based on the cars handled under this system during the fiscal year 1927-28, the costs obtained average one per cent lower per car than the standard allowance granted.

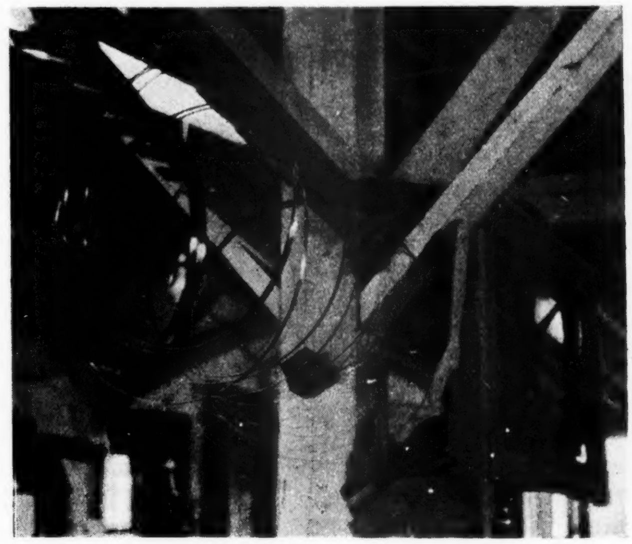
The operation of the cost-control systems has not necessitated providing a large clerical force. In fact, much of the data required must be obtained in part or in whole for other purposes, so that only a relatively small amount of additional work was created by these systems.

Co-operative Meetings Held

Appreciating the fact that the workmen exert a large influence in the successful operation of a shop, the C. M. St. P. & P., just prior to the reorganization of Milwaukee Shops, created a scheme of holding co-operative meetings, the first of which was organized and held at the Milwaukee Shops passenger department. In these meetings there is a shop-craft representative from each of the coach departments, and also, as company representative, the supervisor. In addition, there are representatives of the stores department, bridge-and-building department and engineering department. The passenger-shop superintendent acts as chairman of the meetings, which are held at least once a month, and records of the minutes are kept and published. At these meetings, shop problems are frankly discussed and if necessary, are referred to the proper authority for decision or action. Many exceptionally good results have been obtained from these meetings, and a better spirit on the part of both the shopmen and supervisors now prevails. By means of these meetings, misunderstandings are cleared away, and both the shopmen and the supervisors are able to better understand each other's problems. At frequent intervals, foremen's meetings are also held to discuss problems of supervision, etc.

Keeping Band Saws Sharp

LIKE any other edged tool, the efficiency of a band saw depends on the degree of sharpness and the general condition of the saw. Convenient racks, upon which the saws may be hung within easy reach of the machine, are made from 1-in. by 6-in. boards, with slots cut in one edge, as shown in the illustration. The racks are nailed up to a post, or brace, with the slots on the under side, and at an angle which makes the slots parallel with the horizontal center line of the post. In this way the cutting edges of the saws may be kept from coming in contact with any metal, and are always up out of the way when not in use.



A unique method of storing band-saw blades

*Developments in Equipment Painting**

New method of protecting lading from oil in car floors

IN accordance with instructions, we issued a questionnaire to all railroads inquiring as to their experience in the use of lacquer finishes.

Replies were received from 70 railroads—44 reported that they had applied lacquer on their equipment, ranging from one passenger car or locomotive to 600 cars on interior and exterior, and 26 railroads report that they have not applied lacquer on any of their equipment.

Of the roads using lacquer, 26 report that lacquer gives better service than paint and varnish. Ten roads report that lacquer is equal to paint and varnish and eight roads report lacquer is inferior to paint and varnish.

The principal objection made against the use of

* Abstract of a committee report presented before the meeting of the Equipment Painting Section, American Railway Association, at Montreal, Que., September 11, 12 and 13.

lacquers is based upon the statement that it wears off on projecting rivet heads and other parts of cars. It also seems that on railroads which have a light color, such as tuscan red or orange chrome, the claim is made that the color is fugitive and fades out.

Summing up the information received by this questionnaire and our own personal experience and knowledge gained by study, we are of the opinion that the manufacture of lacquer is in an evolutionary stage. The solvents formerly used were not only offensive but were also injurious to the operator if used in a close room. These have been eiiminated. Improvement has also been made in the manufacture and application of brush lacquer. Many divergent views have been expressed for and against the use of lacquer, but it is generally agreed that in territories that have strong alkali water, lacquer gives better service than varnish. It is also conceded that lacquer is easier cleaned.

Car Floor Sealers

At the request of the Mechanical Division of the A. R. A., this section took up the best method of cleaning car floors to protect shipments.

Investigation developed the fact that some roads used a sandblast. Objection to this brought out the fact that this method roughened the floors and it then absorbed the oil more readily. Some roads used a torch. The fire hazard made this plan objectionable. Other roads used an alkali solution. This only cleaned the surface and the oil syphoned up and caused damage to the contents of the car.

Your committee, having this information, conceived the idea of getting some material that could be sprayed or brushed on, to seal in the objectionable matter. We have induced the paint manufacturers to furnish material for test and we are in a position to state that three firms are in a position to supply any demand made. The committee in tests has used products at several prices; the cheaper ones sealed in a light coating of grease, but a heavier coating came through later on.

When the cost of a new floor or part of a floor is considered, your committee believes that it is economy to use the high-cost product and hope that just because it is a paint product, the theories so many times applied to buying paint materials, that one grade is just as good as another, will not prevail.

Fire Hazard

The answers to our questionnaire bring out the fact that in all the shops reporting, only six fires occurred, and none of them were lacquer. Five originated by use of varnish remover; one by spontaneous combustion. All of them were due to carelessness; only one could be charged to painters. Material of a highly volatile nature is always liable to cause a fire and, if confined, is apt to explode. In case of fire, lacquers and lacquer thinner, varnish removers, paint oils, alcohol, gasoline and turpentine should be classed as highly inflammable. Linseed and other drying oils are subject to spontaneous combustion if used in wiping or polishing with a rag.

One of the most tedious and undesirable jobs in the paint department is rubbing rough stuff. This work is generally assigned to helpers, yet the entire appearance and durability depends largely upon the surface secured. Your committee having the above facts in mind visited the American Locomotive Company's shops and witnessed the operation of a disc run by a pneumatic machine, the picture of which is submitted herewith.

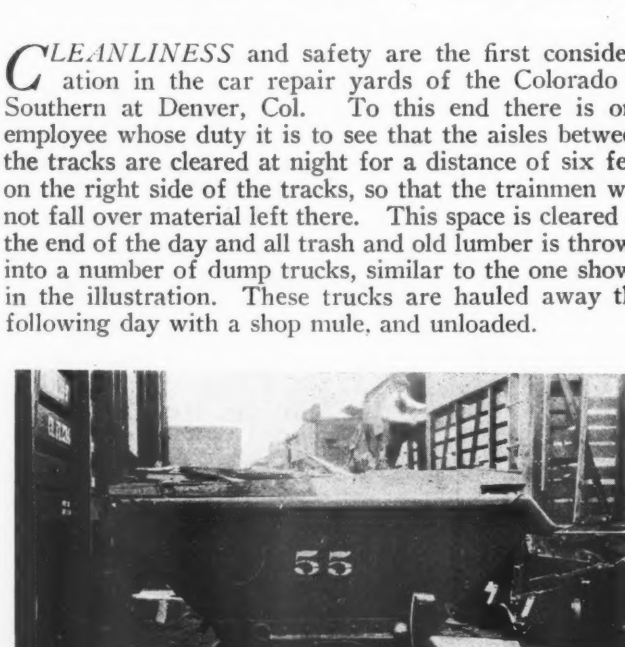
Your committee witnessed a demonstration of car washing with the device at the Pittsburgh Yards of the B. & O. It is an economical arrangement that will clean a passenger coach satisfactorily without injury to the surface, but, in our opinion, it will not be economical when less than 25 cars per day are handled.

Your committee was instructed to investigate the visibility of aluminum paint on the front end of cars. The tests indicate that this paint is very easily dirtied and hard to clean. One street railroad that has adopted it as standard for painting the front end of cars, after several months' test, changed back to the orange-colored enamel formerly used. However, tests have proved that aluminum paint is a deflector of heat.

The report was signed by J. W. Gibbons (chairman), general foreman, passenger car department, Atchison Topeka & Santa Fe; B. E. Miller, master painter, Delaware, Lackawanna & Western; K. J. Johnson, foreman painter, Nashville, Chattanooga & St. Louis; B. F. Fultz, foreman painter, New York Central (Ohio Central Lines); G. S. Corson, foreman painter, New York Central and Marceau Thierry, foreman painter, Norfolk & Western.

Cleanliness Promotes Safety

CLEANLINESS and safety are the first consideration in the car repair yards of the Colorado & Southern at Denver, Col. To this end there is one employee whose duty it is to see that the aisles between the tracks are cleared at night for a distance of six feet on the right side of the tracks, so that the trainmen will not fall over material left there. This space is cleared at the end of the day and all trash and old lumber is thrown into a number of dump trucks, similar to the one shown in the illustration. These trucks are hauled away the following day with a shop mule, and unloaded.



At the end of each day scrap material left in the car repair yards is loaded into dump trucks of this type

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Car Owner's Signature Sufficient under Certain Conditions

On December 26, 1925, the Terminal Railroad Association of St. Louis, made repairs to New York, New Haven & Hartford car No. 91251, which consisted of applying one second-hand A.R.A. riveted yoke Tower coupler, 5-in. by 7-in. shank, complete, two yoke rivets, six carrier-iron bolts and eight draft pan bolts. On February 7, 1926, the car owner presented a joint-evidence card signed by a New Haven inspector showing that, at the "B" end, the car had one 5-in. by 5-in. by 8½-in. butt Sharon coupler, instead of one 5-in. by 7-in. by 8½-in. butt Climax coupler. The repairing line refused to honor the joint-evidence card for the reason that the card did not comply with Rule 12, inasmuch as it had not been signed by a joint inspector or by two inspectors, one representing the owner and the other a railroad company which is a subscriber to the A.R.A. Interchange Rules. The owner explained that, on account of the congestion in its Boston terminal during the day, it was necessary to handle practically all of the interchange work at night and thus it was impossible to make any repairs or to secure joint evidence. In the case in question, the wrong repairs were not noticed at the time of interchange, but were discovered when the car was placed on the repair track at the Boston freight terminal. On account of the distance between the repair point and the point of interchange, it was not considered practicable to request joint inspection. The Union Freight Railroad Company, which handles the cars between the terminals of the Boston & Maine and the New Haven, is not a subscriber to the A.R.A. rules of interchange and, therefore, is not eligible to participate in a joint evidence statement.

The decision of the Arbitration Committee was to the effect that "the contention of the Terminal Railroad Association of St. Louis was not sustained."—*Case No. 1577—Terminal Railroad Association of St. Louis vs. New York, New Haven & Hartford.*

Prices in Effect on Date of Actual Dismantling of Car Applied

Under date of July 8, 1927, the New York, Chicago & St. Louis reported Maine Central box car No. 8690 to the owners under Rule 120 and requested disposition. On July 19, 1927, the owner authorized the N. Y. C. & St. L. to dismantle the car. The Maine Central received, on August 31, 1927, a statement that the car had been completely dismantled on August 29, also showing the value of scrap material from the car which amounted to $134.23, less the cost of dismantling, $45.00, leaving a net charge of $89.23. The owner took exception to the dismantling line's statement on the belief that, as the car was actually dismantled on August 29, 1927, under Supplement No. 1, Rule 107, effective August 1, 1927, Item No. 446 (which places this car under class "F"), the cost of dismantling should have been $27 as per Item No. 447, Rule 107.

The Arbitration Committee stated that "The contention of the Maine Central is sustained. Labor for dismantling at prices in effect on date car was actually dismantled apply."—*Case No. 1578—Maine Central vs. New York, Chicago & St. Louis.*

Must the Wheels Touch the Ground Before a Car Is Considered Derailed?

On September 1, 1927, as a Bessemer & Lake Erie train was approaching a tower, the brakes were applied and went into undesired emergency causing Bangor & Aroostook car No. 9223 to buckle. The handling line claimed that the car was not subject to any of the conditions listed under Rule 32 because it had not been derailed (the trucks, owing to the buckled condition of the car, were suspended in the air and did not leave the rails until the cars at each end of the buckled car had been removed. The B. & L. E. took the position that, technically, a car cannot be considered derailed until the wheels touch the ground. The Bangor & Aroostook claimed that the car had been derailed and, therefore, was subject to the provision of Rule 32, making the Bessemer & Lake Erie responsible.

The Arbitration Committee in rendering its decision stated that "The conditions in this case constitute a derailment and come within the intent of Rule 32; therefore, the Bessemer & Lake Erie is responsible."—*Case No. 1579—Bessemer & Lake Erie vs. Bangor & Aroostook.*

Responsibility for Cistern Shifting on Tank Car

On March 12, 1927, while a Pennsylvania locomotive was spotting CLX tank car No. 42, loaded with gasoline, the cistern shifted on the underframe 3½ in. toward the B-end because of the anchorage bolts shearing off. It is admitted that some of the bolts were in place and some were missing prior to the accident. The missing bolts were indicated by the rusted condition of certain bolt holes. The parties making the joint inspection assumed, or compromised, that fifty per cent of the anchorage bolts were in place and the remainder were missing. The buckled center sills bulged outward and there were old cracks forward of the bolsters which which had been previously re-inforced by the application of unflanged plates extended from a point 6 in. from the sill ends to a point 13 in. in the rear of the body bolster, A-end, and to 36 in. in the rear of the body bolster, B-end. The owner contended that the damage was the direct result of unfair handling and, therefore, the car was subjected to Section D of Rule 32. The handling line contended that the car had not been subjected to any of the conditions outlined under Rule 32 and, furthermore, that it had furnished the owner full information and a statement of circumstances, as required by Rule 44.

The Arbitration Committee stated that "The car had not been subjected to any of the unfair conditions of Rule 32. A statement as to how the damage occurred was furnished, as per Rule 44. The owner is responsible."—*Case No. 1583—Crew Levick Company vs. Pennsylvania.*

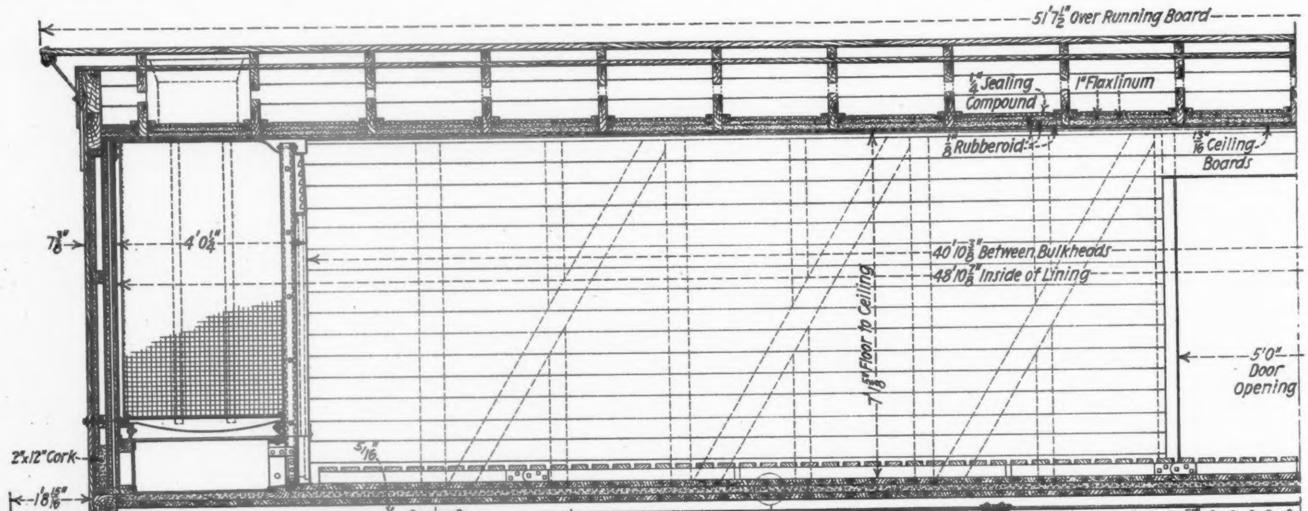
New passenger-refrigerator built by the General American Car Company for service on the Missouri Pacific

Passenger-Express Refrigerator Cars

Built by General American Car Company for leasing to railroads to move American Railway Express Company shipments

THERE has been a steady growth in the handling of perishable freight by express in refrigerator cars in the last few years, and every evidence points to a continued increase in this movement, due to the accelerated service permitting fruits or vegetables to arrive at their destination in better condition. The American Railway Express Company was the leader in providing a larger and more suitable equipment to handle this traffic. At its suggestion, the general American Car Company has built and is the owner of several hundred new passenger-refrigerator cars which are leased to the railroads. Among them are 100 new cars for the Missouri Pacific, one of which is illustrated.

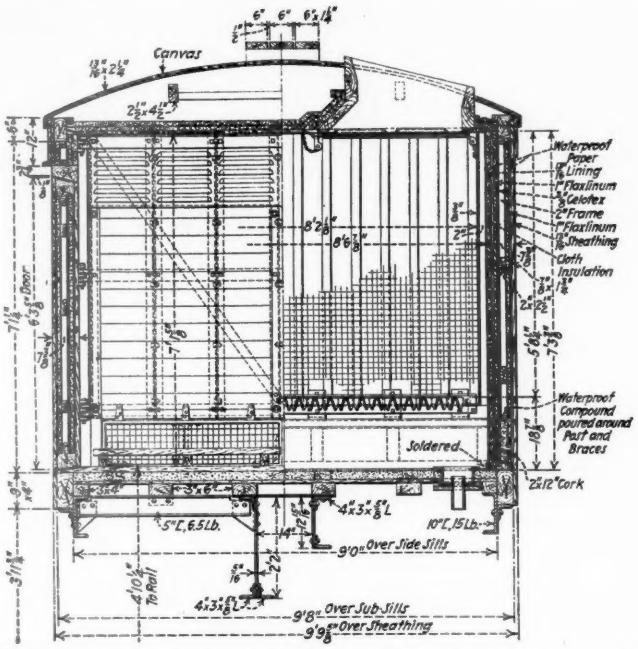
This is the latest development in a passenger-refrigerator car, built according to specifications of the American Railway Express Company. It is 53 ft. 6 in. long over the buffers, equipped with an unusually heavy steel underframe, Commonwealth one-piece cast steel truck frames with pedestals integral, rolled-steel



Elevation and partial longitudinal cross-section of new

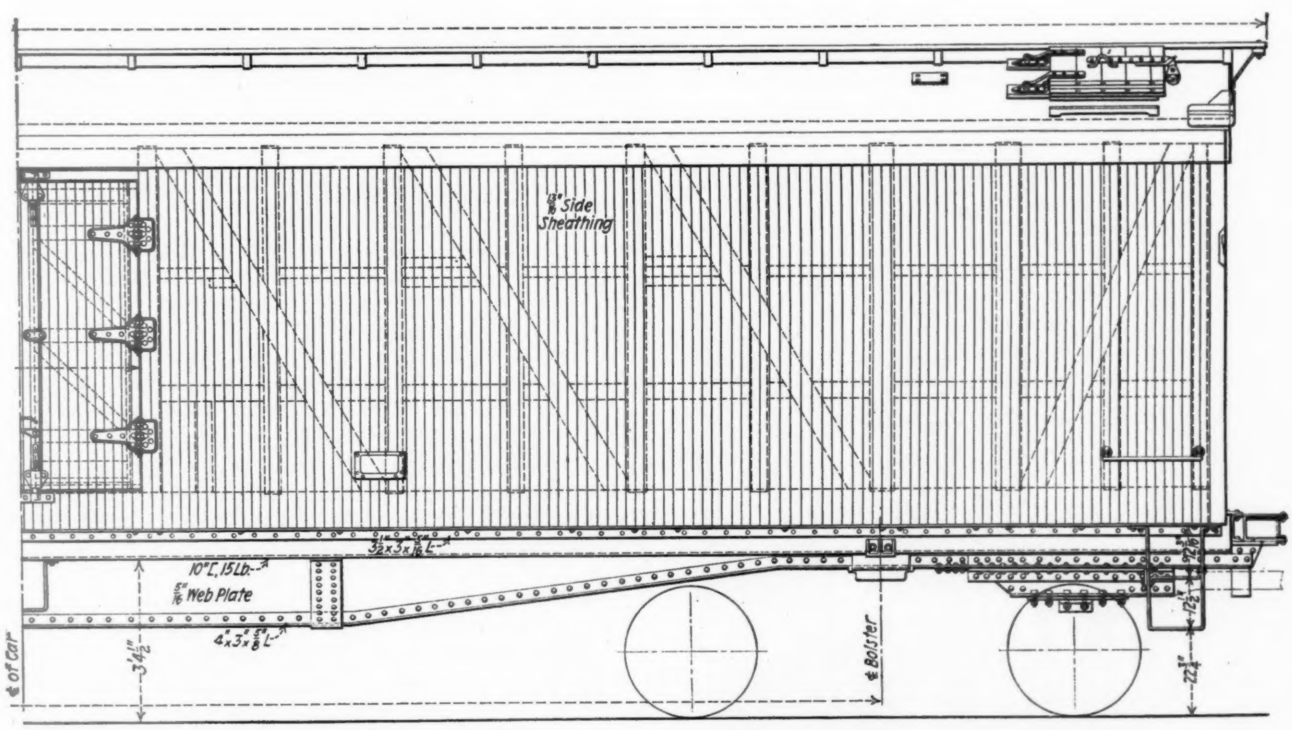
wheels, high speed passenger brakes, steam and air signal connections, and effective insulation.

Among the special features of the car is the provision



Cross-section showing insulation details, also hinged metal bulkheads

of collapsible, hinged, metal bulkheads that can be opened for the easy cleaning of ice out of the bunkers and which also permit the use of the full length of the car for dry express matter, parcels post or storage mail.



passenger express-refrigerator built by General American

The ice bunkers, with a capacity of 317 cu. ft., will accommodate 11,700 lb. of ice, which is the largest capacity of any bunkers constructed up to this time and insures a long haul with a single icing. The cars are unusually well insulated, having heavy cork floors with hairfelt and other modern types of insulation in the walls, ends and roof.

The several hundred cars of this type, owned by the General American Car Company are now leased to railroad companies because they represent a type of equipment that lends itself to pool operations by the express company. The fruit and vegetable season on most railroads is very short and does not justify ownership of this type of car by individual railroads. The movement of these and other passenger refrigerator cars, covers the entire United States and is another step in the broadening out of markets for fruit and vegetable growers throughout the country.

Insulation Details

The following description covers the general method of insulating the new passenger express refrigerator car:

Floor—On top of the subfloor is laid a course of two-ply 35-lb. insulating paper in two widths lapped at the center. Above this is a course of 2-in. cork board and the top of this is given a coat of hot waterproofing compound about 1/4 in. thick filling all cracks and crevices. On top of this is another course of 35-lb. paper, above which the main floor is applied.

Side and End Walls—Starting from the inside lining the insulation is as follows: 7/8 in. air space, one course of 90-lb. insulating paper, 1 in. hairfelt or flaxlinum, one course of 90-lb. paper, 1/2 in. air space, one course of insulating cloth and sheathing. At the bottom cork board 2-in. thick, 12-in. high is applied from the floor line to 12 in above this board, set in between posts and braces, and covered with hot waterproof compound.

Roof—On top of ceiling is one course of 2-ply 35-lb. insulating paper, two courses of 1 in. flaxlinum or hair-felt, one course of two-ply 35-lb. paper and, on top of the last course, 1/4 in. of hot waterproof compound.

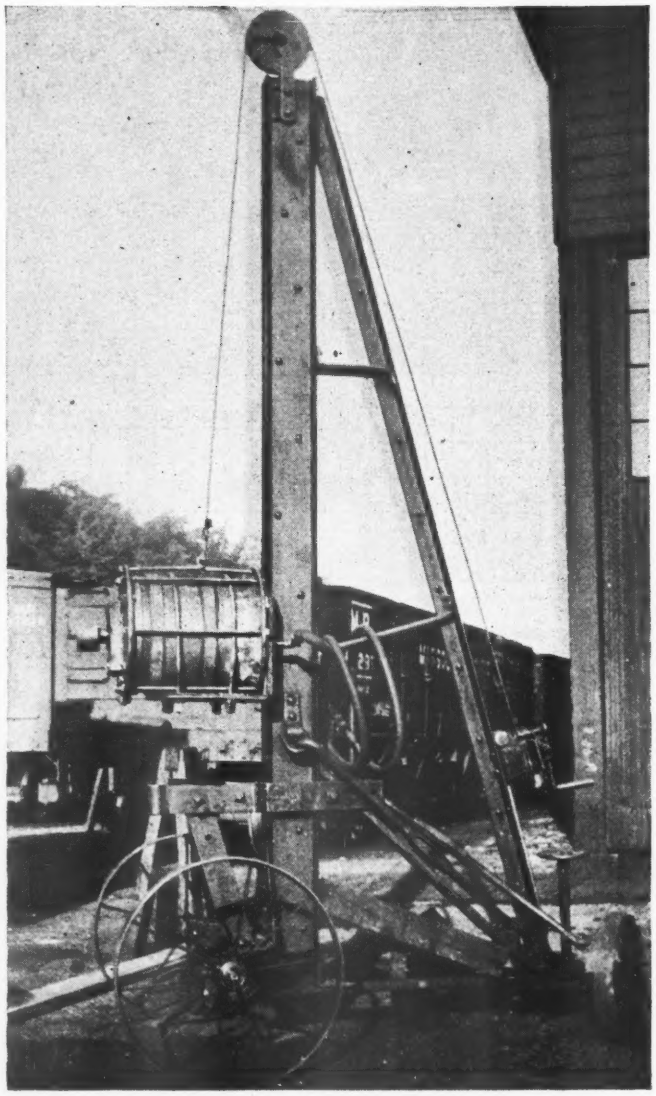
The more important details of construction, including the insulation are shown on the drawings.

Effective Treatment of Bulging Ends

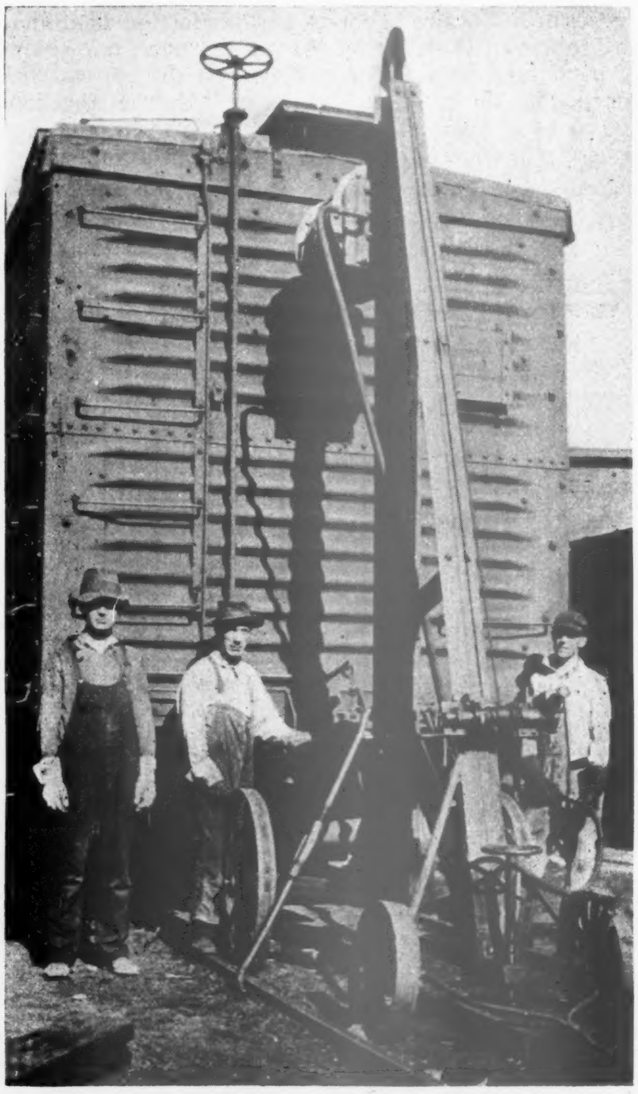
THE straightening of steel ends in place on freight cars always has been more or less of a difficult and vexatious problem for car men. Among the methods of meeting this problem is one of unusual interest, developed by P. A. Fisher, steel car foreman at the Kansas City shops of the Missouri Pacific.

In the construction of this device, an 8-in. I-beam, long enough to reach slightly above the top of the highest box-car, is mounted in a vertical position on a channel bed supported on four truck wheels. The I-beam is reinforced by two 3-in. angles forming the oblique member. Two intermediate bar strips serve to stiffen the framework, which is securely riveted throughout to form a rigid unit.

A 16-in. air brake cylinder is arranged to slide vertically on the outside flanges of the I-beam, with its center line at right angles to the beam. This cylinder is elevated and lowered by a small hand winch secured near the bottom of the oblique member and connected to the cylinder by a flexible steel rope operating over a sheave at the top of the frame. A flexible hose connects the air cylinder with the nearest air line. Two hinged round iron bars, equipped with turnbuckles, are provided to steady the frame by clamping it to the rails, and a screw and hand wheel arrangement permits taking the load off the front wheels when pressure is applied in the air cylinder.



Side view showing construction details



Method of clamping to the rail and relieving the pressure on the front wheels

In operation, the device is placed between the rails at the car end which requires straightening and the coupler knuckle is removed. A substantial connection is made to the car by means of a link bolted to the frame of the device, the end of which is inserted in the coupler and held by the knuckle pin. The rail-clamping rods are applied and the turnbuckles tightened, a block being applied under the hand-wheel screw, which is also set up. The device is then ready for operation and the car end can be straightened by raising or lowering the cylinder to the desired location and applying air pressure which transmits pressure through suitable blocking to the car end. The blocks are formed to fit the corrugation of the pressed steel ends and the straightening operation is performed without deformation of the pressed sections.

The 16-in. cylinder, using 100-lb. air pressure, develops approximately 10 tons pressure, but in actual prac-

tice, only enough pressure is used to straighten the sheets. The effectiveness of the device is shown by the fact that in one month 98 steel ends on both open-top and house cars were straightened at an average cost of two man-hours per end, representing a man-hour saving of approximately 85 per cent.

Some Facts Concerning Nails

By Raymond J. Hoyle

Assistant Professor of Forest Utilization, New York State College of Forestry, Syracuse, N. Y.

FOR many years the lumber industry has had some difficult problems to solve, and the products of this great industry have been given some hard blows through no fault of their own. One of the factors which often affects lumber adversely is the nail which is only one of several adverse factors that is beyond the control of the lumberman.

Nails are nails; but wood has a great variety of properties which vary greatly between kinds, location in the tree, and even in the same piece of lumber. These are the general conclusions of the man who uses but a few nails in a lifetime, the wood-worker or even the technical man. Nature does not grow wood uniformly and neither does man make nails uniformly. Nails are hard, soft, or brittle just the same as wood. Nails are a by-product of the steel industry and, because of the method used in making the steel and wire from which they are made, the properties of the nails within the same keg may vary greatly. Nails are often made from all classes of steel which accumulate, from excess on orders, scrap and off-heat stock. Nails bend easily, the heads snap off or they shear or fatigue readily in service often because of the poor quality of steel in the nail. In the case of barbed nails, the barbing process tends to crack the steel and causes an early failure.

There is a great deal of room for improvement in manufacturing a nail that is tough and stiff, and not too soft or brittle. Soft nails bend and brittle nails break. Nails should be made to specifications on the kind and quality of the steel.

When a nail is driven into wood the sharp point of the nail wedges the fibers of the wood away from two sides of the nail along the direction of the grain. This wedging apart of the wood fibers leaves a small, open space on two sides of the nail where there is no holding power and where water can enter the wood and cause much damage to any construction subjected to moisture. Moisture working under the head of the nail can readily follow along the shank of the nail in these two open spaces and it is then but a matter of time, in some cases but a few years, before the nail has rusted entirely through on the shank or to such an extent that it is greatly weakened. Weakened nails consequently fail when slight pressure is put on them. A few common nail failures of this kind can be seen daily in wood shingle roofs which have to be replaced, siding of buildings which has to be renailed, and the roofs, siding and lining of freight cars which have to be frequently renewed.

In order to overcome this problem of rusting nails, users of nails have turned to heavier nails but have apparently forgotten that as the diameter of the nail is doubled the wedging and splitting effect is increased four times. The area of a circle increases as the square of its diameter and not as its diameter. The use of a heavier nail will cause much more splitting and permit more moisture to reach the shank of the nail at an earlier date, thus increasing the rusting effect.

Even though heavier nails are used, they will shear as well as the lighter nails if the steel is brittle. Nails are sometimes used with too large a diameter for the thickness and kind of wood. The shearing of nails in railroad cars is probably due to variations in the quality of the steel. In order to eliminate the rusting effect it is advisable to use hot zinc-coated nails in many instances. A keg of nails weighing 100 lb. when zinc-coated can be bought for about $2.00 more per keg than nails that are not coated, but the penny-wise pound-foolish policy of many users of nails continues with the uncoated nail and high maintenance costs. The additional cost of hot zinc-coated nails for a railway car would be about $10.00. The importance of this slight additional investment on a car costing as much as $3000 is very evident. Refrigerator cars after six or seven years of service are often brought in for repairs because of nail failures. If this car could be kept in service several years longer it would be of decided financial advantage.

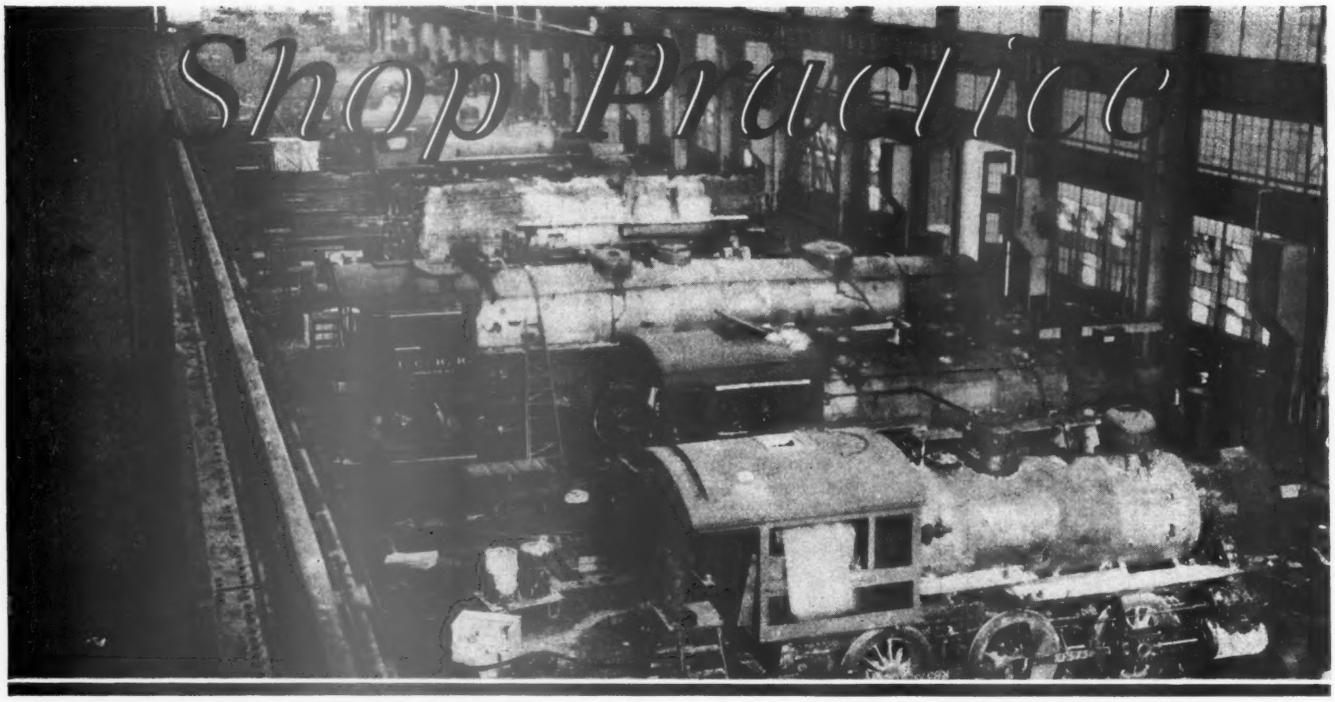
It is often a good policy to increase the length of a nail, rather than the diameter, if greater holding power is desired. The failure and shearing of nails is often due to the barbs or to brittle steel rather than to the nail being too small in diameter.

Some years ago the barbed nail was introduced and used widely in some classes of trade, because it was thought to have a greater holding power. This nail has been incorporated in the specifications of some nail users and is still being used although it has been proved beyond a doubt by commercial and private testing laboratories that this barbed nail has a much lower holding power than the bright nail. Another important point is that the barbing process in addition to decreasing the diameter of the nail at that point has a tendency to crack the steel. Both of these conditions decrease the life of the nail in many types of service.

Judgment and sound reasoning in the use of nails, together with a knowledge of how wood reacts to the nail, will save vast sums of money in repair bills every year in this country, and will increase the life of the lumber used, thereby making it a more desirable material for many purposes. The lumber industry would be greatly benefited if nails were made of uniform steel that would provide toughness and stiffness, rather than the steel that is used today.

SPECIFICATIONS FOR MECHANICAL RUBBER GOODS.—The Rubber Association of America, Inc., 250 West 57th Street, New York, has issued a 40-page booklet, entitled "Specifications for Mechanical Rubber Goods," which presents in convenient, compact form the complete text of all up-to-date specifications and other requirements covering mechanical rubber goods adopted by the Mechanical Division of the American Railway Association. The year of adoption and the effective date of each specification is shown for ready reference.

WASHFOUNTAINS.—The Bradley Washfountain Company, 2203 Michigan Street, Milwaukee, Wis., describes in a new catalogue, No. 1028, a complete line of new and improved washfountains for sanitary group washing in railway shops and railway stations. Numerous photographs and diagrams show layouts of representative installations.



Pneumatic Door-Operating Device

By P. L. Neary

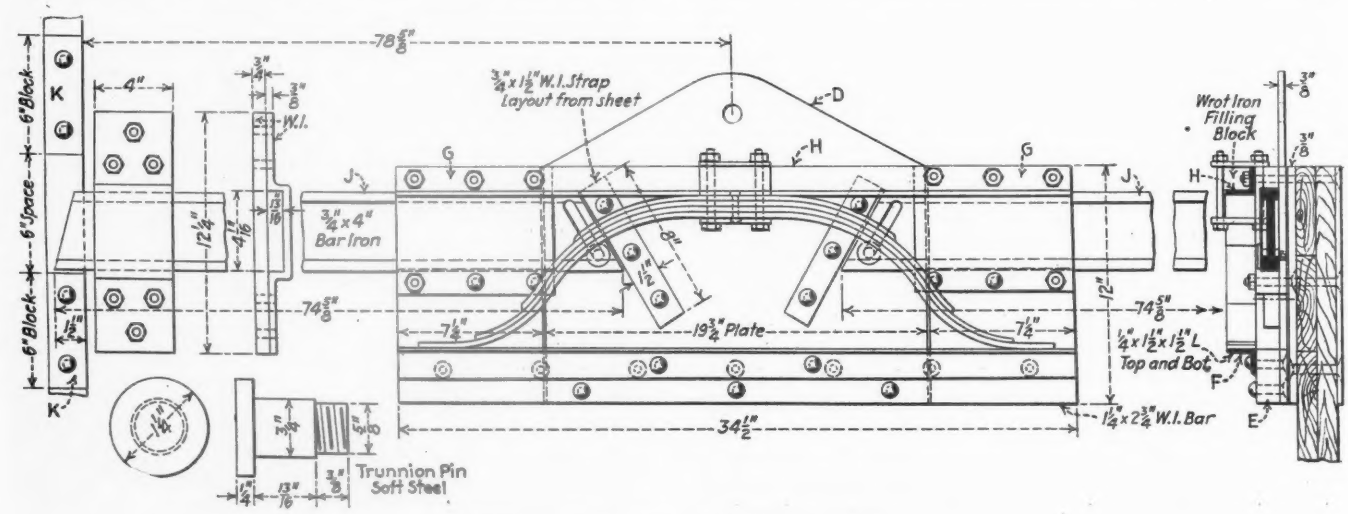
Shop Draftsman, Delaware, Lackawanna & Western, Scranton, Pa.

THE general arrangement drawing shows the application of a quick-action door-opening device for opening and closing in a few seconds large doors of shop buildings. This design was worked out to protect workmen from the cold as much as possible and to prevent the doors from being left open for any extended period. The door openings are usually 13 ft. wide and about 16 ft. high and the doors must, of necessity, be of heavy construction. Because of this great weight, any hand-operating device would take man power and several minutes to open and close, which is objectionable.

The doors to which the device has been applied are in two sections, telescoping each other. The lower section raises up half way and the wrought iron braces *A* pick up the other section as it reaches the bottom of the top section. The telescoping feature reduces the head room required to about 9 ft.

The device consists of a cylinder *B* arranged for vertical mounting, fitted with a piston and expander, rod, packing gland and a pulley yoke fitted with pulleys.

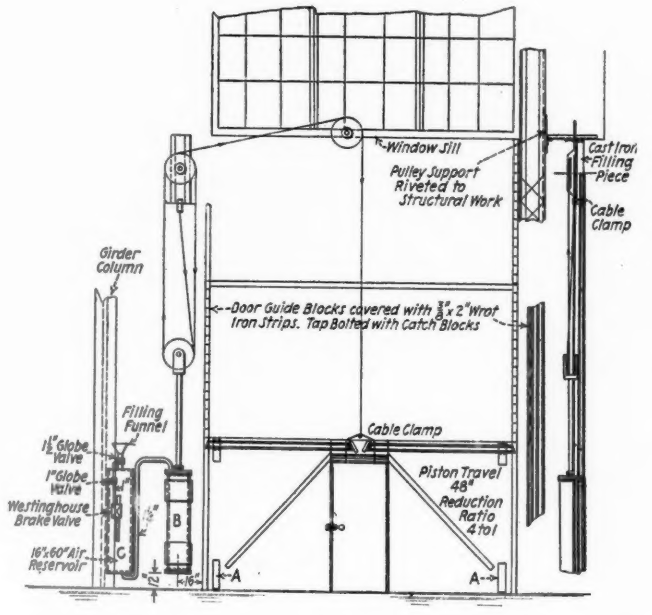
Mounted vertically above the cylinder is another pair of pulleys exactly the same as those actuated by the piston. A wrought-iron bracket is used over a heavy cast-iron filler piece thick enough to form a bearing for the pulley shaft and to center the pulleys in line with the cylinder below. The final pulley, located over the center of the door, is mounted with a shaft and bearings



Application of the semi-elliptic spring

bolted to a substantial 6-in. channel frame riveted to the structural work. The bottom section of the door is fitted with a safety device that is actuated by a semi-elliptic spring.

At first the device appears to be complicated, but



Elevation view of the application of the hydro-pneumatic door operating device

a study of the drawing will show that the rope is fastened to plate *D*, to the bottom of which is attached a filler *E*, outside of which is an angle section *F*. This plate moves up and down between the stop blocks *G*, right and left. The top angle *H* supports a semi-elliptic spring. A sliding bar, right and left engages the stops *K* bolted on to the outside edges of the door guides.

As soon as the slack is taken out of the cable, the plate *D* compresses the spring as it moves up. By the time it reaches the stop blocks, the sliding bars *J* have been disengaged from the sides and the door moves up. If the cable should break or be disconnected, the sliding bars shoot out and engage the stops on the guards and prevent the doors from falling.

Alongside of the cylinder a 16-in. by 60-in. air reservoir is mounted on the wall with ⅞-in. U-bolts. The top is provided with a valve and filling funnel. The reservoir is filled with oil. The air line is fitted with a Westinghouse straight-air brake valve. The admission of air through the brake valve makes the device very sensitive and instantly responsive. The cable arrangement is clearly shown and the piston travel can be arranged to suit almost any desired height, the reduction ratio in this case being four to one. The door will travel four times the piston travel.

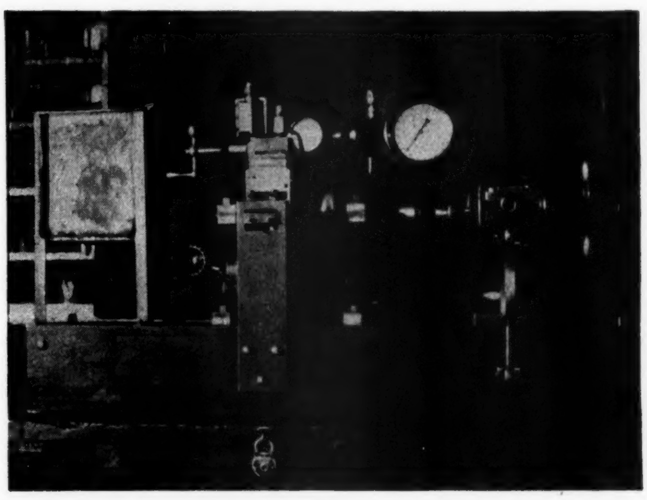
Gasoline Locomotives.—General and condensed descriptions of Milwaukee Type H gasoline locomotives, in which many improvements have been incorporated, are contained in Publication No. 150 issued by the Milwaukee Locomotive Mfg. Company, Milwaukee, Wis. The condensed descriptions cover locomotives weighing from four to twenty tons. General instructions for the operation and care of the Type H four-speed gasoline locomotives are listed in detail in Publication No. 151.

A Device for Testing Air Motors

The toolroom at the Canadian National shops at Winnipeg, Manitoba, besides handling local air-motor repairs, is also responsible for the maintenance of motors that are sent in from many smaller points on the system. Consequently, a large number of motors of various types are overhauled and repaired annually. Believing that some form of testing device would be valuable as a positive means of detecting doubtful work and would at the same time furnish some interesting information, the repair department, under the direction of B. S. Duncan, constructed a testing device.

The principle of the device is that the motor drives a spindle on which is mounted a brake drum. Resistance to the rotation of the brake drum is developed by two brake shoes which are mounted in such a manner that their resistance may be gradually increased or decreased, thereby building up or reducing the load on the motor.

The motor to be tested is mounted and held securely by clamps. It is coupled to the brake spindle by a suitable driver or dog. The brake spindle is mounted on ball bearings which reduce friction to a minimum. A brake drum is mounted on the spindle, and partly surrounding the drum are two bronze-lined brake shoes. One end of the lower shoe can be seen projecting through the mounting slot in the vertical steel plate. Grease cups were fitted to the brake shoes at



Air motors may be quickly and accurately tested in this device

first, but were later replaced by graphite cups, as the latter proved to be a superior lubricant for this purpose. To apply a load on the motor, the handle in the center foreground is given several turns which forces oil into a small cylinder. A ram in this cylinder is displaced by the oil and exerts pressure on the brake drum through the medium of the brake shoes. A pipe leading from the small cylinder is coupled to the pressure gage which indicates from zero to a maximum pressure of 2,000 lb. This range covers all types of motors.

During a test, considerable heat is developed at the

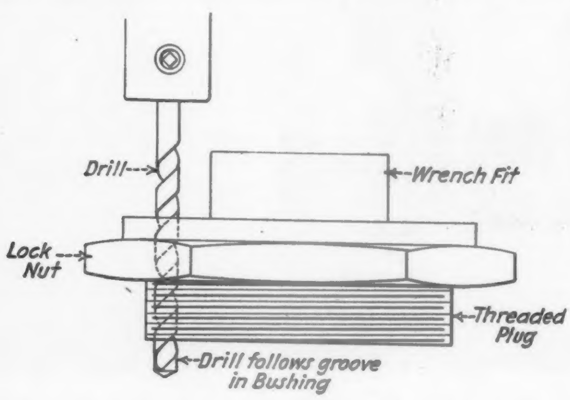
braking surfaces. In order to meet this condition, the left end of the brake spindle was bored out and the brake drum also made hollow to allow water to enter from the welded tank shown at the left. A simple stuffing box prevents leakage where the spindle enters the tank. The cooling water is assisted in its circulation by a stationary vane which is fastened inside the tank and which extends into the hollow part of the spindle.

The consumption of air in cubic feet per minute is obtained by reading the air-flow meter shown at the left of the pressure gage. To the right of the air gage is a large tachometer gage, which is driven by a belt that passes over a pulley mounted on the brake spindle and registers the revolutions per minute of the motor at varying loads. A special countershaft is provided underneath the tachometer mounting and is used when compound motors are being tested, as these run at slower speeds.

Tests were made with a motor of each type used that was known to be in perfect running order. From the data obtained, it was possible to make charts that showed a standard for each type of motor, as to the air consumption and the revolutions per minute at high, medium at low speeds under certain loads. If a motor, placed on test after being repaired, performs within a reasonable limit of the standard requirements, it is placed in service. If it fails to pass the test, it must be checked over until the trouble is located and remedied.

Removing Reverse-Valve Bushings

A *REVERSE*-valve chamber bushing is forced in place under pressure and when it is necessary to remove it the operation is somewhat difficult, unless proper equipment is available. The illustration shows a



A tool for removing reverse valve chamber bushings

tool, devised at the Denver shops of the Denver & Salt Lake, which makes the removal of these bushings a comparatively easy matter.

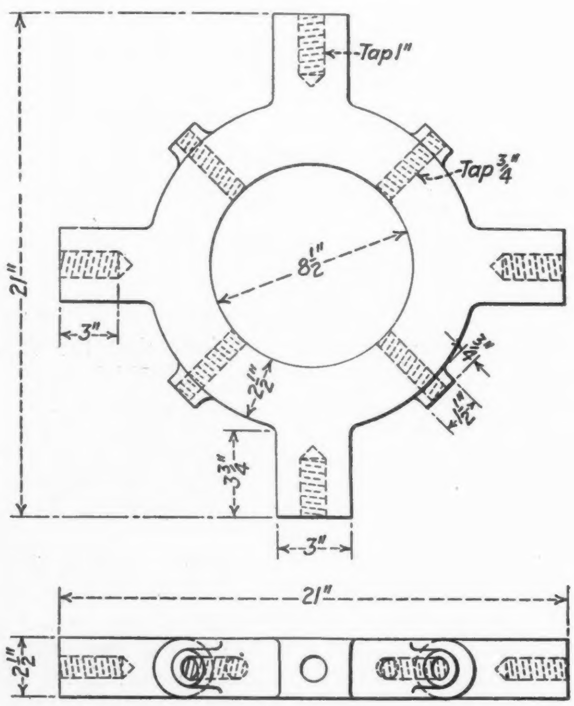
The reverse-valve chamber cap is removed and a threaded plug with a large lock nut is screwed down in its place. A hole is bored through the plug so that it will come flush with the groove in the valve bushing when the plug is tightened. A drill is inserted in this hole which guides it down the groove, cutting through the bushing from top to bottom. This relieves the pressure of the fit and the bushing is easily removed.

Spider for Cylinder Boring Bars

By H. C. Spicer

Erecting Shop Foreman, Atlantic Coast Line, Waycross, Ga.

IT is sometimes necessary to face the ends of locomotive cylinders after welding repairs. This work is difficult to do with the conventional type of cylinder boring bar because the cross-arms and brace will not permit the tool to come out far enough to face the ends. The spider shown in the illustration permits the cylinder ends to be faced in one set-up.



A spider used with a cylinder boring bar when facing off cylinder ends

The maximum diameter of the spider is 21 in. With ferrules placed over long set screws, it can be used in cylinders of various diameters. The spider is fastened in the cylinder near the end by four set screws. The cylinder-bar floating bearing is held in the center of the spider by four set screws. By using the spider, the cylinder ends are free from obstructions and can be readily faced off.

JACKLIFTS.—Lift trucks, ranging in capacities from 2,000 lb. to 10,000 lb., are illustrated in the Special Lift Truck Edition of the Jacklift and Stacker Practice bulletin prepared by the Lewis-Shepard Company, 168 Walnut street, Boston, Mass.

ON THE SEVENTH OF JANUARY, one of the Canadian National oil-electric rail cars finished 14 months' operation without a single day out of service. The distance traveled by the car during this period was about 170,000 miles.

Manufacturing and Gaging Taper Frame Bolts

The machines best suited for this work are described in the concluding installment of this article—Machines selected on basis of output desired

Part II *

AS a general proposition, frame bolts are made from wrought iron, low carbon open-hearth steel or, where great strength or wearing qualities are demanded, a higher carbon steel is used similar to that used for car axles. All of these metals can be readily headed in the regular bolt-heading machines.

The older and more common practice of finishing frame bolts has been to use center lathes, the output of which, when compared with the output obtainable by special machines for this purpose, is low. However, it is a question if in every-day service, in order to take care of the odd sizes required for locomotive repairs, the lathe practice will ever be entirely done away with.

Finishing frame bolts on center lathes does not present features calling for special mention. The general practice is first to center the blanks, which is preferably done on double-end centering machines. In some shops they are centered on drill presses equipped with a universal two-jaw vise, similar to a universal chuck which holds the bolts central with the drill-press spindle. One form of a special centering machine has a semi-automatic arrangement for centering the bolts.

Practically all of the lathes used for this purpose have taper-turning attachments which, when properly adjusted, admit of turning any length of bolt without altering the taper adjustment other than to take care of the wear of the lathe centers.

Owing to the soft nature of the material, it is customary to operate the lathe at a speed between 200 and 300 r.p.m., agreeing with a surface speed between 80 and 100 ft. per min. The feeds used generally average between 1/64 in. and 1/32 in. per revolution. With slow feeds and the cutting tool in good condition, the resultant finish is smooth, which admits of applying the bolts without the necessity of filing. As a general proposition, it has been found advisable to take a roughing and a finishing cut. A skilled workman, after grinding the cutting tool, generally sets the micrometer dial on the lathe cross slide when turning the first bolt. When turning other bolts of a similar diameter, the tool is adjusted to the micrometer dial readings and when turning larger or smaller bolts, the adjustments are obtained from the dial. This practice eliminates considerable time in trying the bolts in the gages. During the turning operation, the under side of the head is faced and the end threaded to the correct diameter. After turning, the bolts are tested for accuracy of taper in the internal type of gage or by the use of ring gages. With the internal gage, the practice is to chalk a bolt occasionally and enter it into the gage to insure the correctness of the taper. The bolts are finished to a diameter so that the head extends about 3/16-in. or 1/4-in. distance from the face of the gage. This is to allow for the final tight driving when applying the bolt in the frame.

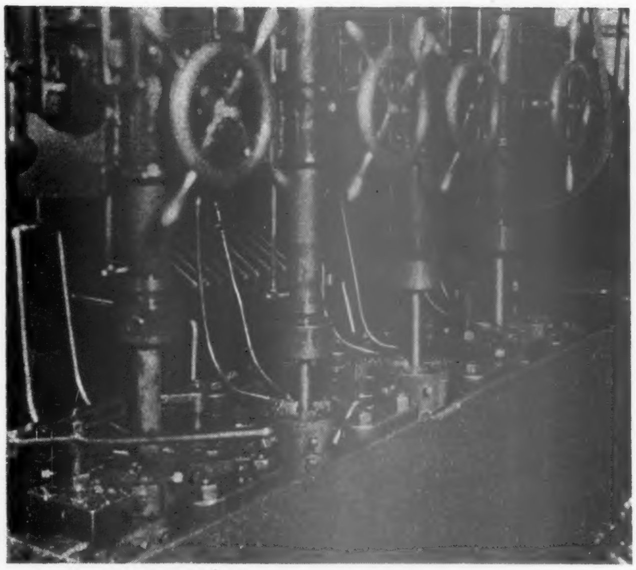
A bolt skimmer machining 1¼-in. by 9½-in. and 1-in. by 6-in taper frame bolts

Where the ring gages are used, one ring should "go tight" at the distance from the head allowed for drive. A second ring gage, when placed on the bolt should "go tight" so that the distance between the faces of the two is equal to the standard taper; that is 3 in. or 6 in.

Pointing Bolts

Before the bolts reach the bolt-skimming machine, they are pointed, which is done by the aid of several forms of home-made devices, one of the more common of which is a converted lathe to which a box tool has been added. The frame of the box tool is threaded so that it can be screwed onto the head of a lathe spindle. The box tool

* Part I was printed in the February issue, page 100.



The cutting heads of the bolt skimmer

may also be made to fit the taper hole commonly used for lathe centers. The concave cutter is held in a suitable slot by set screws. A bushing with suitable internal diameter is held in the frame by set screws and may readily be changed for different sizes of bolts. The contour of the concave cutter is ground to suit the range of sizes of the bolt blanks. However, when the range is not great, one cutter answers for several sizes of blanks. The blanks are held, when pointing, in a hexagon socket fitting in the tail stock. The usual tail-stock screw is often replaced by a lever to increase the output.

In operation, the blanks are placed in the socket, the tail-stock plunger is moved to the left, the bolt entered into the bushing and against the cutter, then slowly moved up until the desired pointing is obtained. This operation requires but a few seconds.

Turning or Skimming Machine

A bolt turning or skimming machine has been developed for the manufacture of taper frame bolts in the larger railroad shops on a quantity basis. The machine is equipped with four cutting heads, two for turning the straight surface of the bolt previous to turning the taper, and two heads for the final finishing of the taper surfaces. The upper section of the machine resembles a drill press, having four revolving spindles, each of which carries a square or hexagon socket which fits over the head of the bolt and drives it. Each spindle is fed downward by power feed which is provided with the usual automatic knock-off common to drill presses for limiting the spindle travel.

The four cutter heads are held in recesses in the frame of the machine. Nos. 1 and 3 are for roughing and Nos. 2 and 4 for the finishing operations. The roughing heads are recessed to hold four cutter blades, which are held in place by set-screws. These blades have cutting edges on the upper end and on the inner side, the arrangement resembling an adjustable hollow mill. The cutting necessary to rough-turn the bolt is done by the cutting edges on the ends of the blades. The bodies of the bolts when completed in these heads are of one diameter from end to end.

The cutters for the roughing heads are set to the desired diameter by placing a bar of hardened and ground steel of the desired diameter in the opening and pressing the cutters against the bar. The cutters are first loosely clamped and adjusting set-screws set up against the blades, the steel bar is revolved and tested for possible shake, after which the final adjustments are made and the set-screws tightened.

In some cases, additional sets of cutters for turning the straight or threaded part of the bolts are held in the lower part of the cutter heads. The heads are arranged for up or down adjustment to accommodate different lengths of bolts.

The setting of the cutters in the finishing head is quite similar to that for the roughing cutters, except that a tapered plug is used. Two of the blades in the finishing heads have cutting edges similar to the roughing heads. The two remaining blades or, more properly speaking, backers are without cutting edges and serve as guides to center and guide the bolt between the cutter blades. These cutter blades and backers must be carefully grounded and adjusted, as the accuracy of the taper and diameter of the bolt depends on them.

Finishing Taper Bolts in Bolt-Skimming Machines

The cycle of operations when finishing the bolts is easy to follow. The bolts are picked up and held in tongs resembling enlarged sugar tongs. They are entered in the hexagon socket of the machine spindle, which is fed down by hand until the point of the bolt enters the roughing head. The power feed is then engaged, which feeds the blank until the underside of the head is faced, at which point the feed is thrown out, after which the operator generally feeds by hand to smooth the underside of the head. The spindle is then raised and the bolt pried out of the cutter head with a small pinch bar. During the above roughing operation, the bolts are turned about 1/32 in. larger than the taper size called for. The bolts are handled in the finishing or taper heads in practically the same manner.

Gages are used to inspect the bolts for diameter and correctness of taper. When satisfactory, they are stocked. In the event of not meeting the requirements, they are laid aside for conversion into smaller sizes.

The machine, as previously mentioned, has two roughing and two cutting heads. Owing to the power feeds and automatic throw-out, the four stations are in operation practically continuously. The operator is thus kept busy feeding, removing and inspecting the bolts.

Where a large number of duplicate bolts is required,

A semi-automatic lathe on which taper frame bolts may be machined

this machine is economical to operate. However, there are certain limitations. Where only a few of one size are required at one time, the time of adjusting or setting the cutter heads becomes a large per cent of the total time required to turn out the lot. Therefore, with small lots, it is often more economical to machine the bolts on center lathes. This is a question that must be determined from the requirements of the local shop, or the possibility of supplying other shops.

Semi-automatic Machine for Centering, Pointing and Turning Taper Frame Bolts

Semi-automatic machines are sometimes used for centering, pointing and head-facing taper bolts. The blank is held centrally with respect to the two center drill spindles by two clamp jaws which are operated simultaneously by a connecting lever. The two center drill spindles are fed to the blank by either of the two handles. Motion between the two is transmitted by a sprocket chain.

A triple-head bolt threader

The finishing of the point end and the facing under the head is done in the upper part of the machine, in which the blank is held, on two lathe centers and driven by a hexagonal socket. The right lathe center is forced into the bolt center hole and locked by a pull and turn of a handle. The bolt is faced under the head by a roughing and finishing tool-holder slide. Each of these three tools is operated by separate cams mounted on the rear shaft. The cams are engaged and go through the cycle of operation when a foot treadle is pressed.

A special bolt-turning machine is used for turning straight or tapered bolts. The machine has four independently controlled spindles. The bolt blanks are held between a lower lathe center located inside of the driver socket and a second lathe center held movably in the upper holder. The latter center is moved into the bolt-center holder and locked in position.

Two of the cutter heads are for rough or straight turning and two for taper turning. The heads move up and down in the upright guides. Each head is fed downward by a separate cam located on the upper frame of the machine. The cam is thrown into gear by the pulling of a handle. The cutter heads resemble adjustable die heads, but the customary chasers are replaced by plain cutting tools. The roughing heads turn one diameter for the entire cut, the same as would be the case when threading a bolt. The cutting tools in the finishing heads are controlled by a taper bar which feeds or, more properly speaking, releases the cutting tools to agree with the desired taper per foot, performing the same operation as would be the case were the adjusting screw of a die head gradually to adjust itself as a bolt is cut. The cutting tools in both the roughing and the finishing heads are adjusted as to diameter by a set screw similar to the adjustment for a die head.

This machine is well adapted for the large or moderate size shop owing to the ease of changing from one size of bolt to another. Also, as the blanks are centered, in the event of requiring one or two odd sizes for a rush job a larger bolt may readily be turned to a smaller size, or an unturned blank made use of.

Grinding Taper Frame Bolts

The question of grinding the taper frame bolts has been considered and in some shops put in practice. At first glance this may look like too great a refinement and too expensive a practice for locomotive repairs. However, after careful consideration, when balancing the possible increase in costs against the superior fitting, it certainly looks as if this will be the practice of the future.

Two general practices look promising for grinding these bolts, one of which is to center and face under the head and point the bolt which can economically be done in the larger shops or in the central production shops on a bolt-centering, pointing and head-facing machine, or in the smaller shops on a lathe. The bolts, after this operation, should be stocked. As the body finish of the bolts would be in the rough, they should preferably be to step sizes, varying by 1/8 in. or 1/16 in., and of a length which practice shows to be the more commonly required.

The finishing operation would be as follows: The bolts would be drawn from stock and ground on a 10-in. by 36-in. or 12-in. by 36-in. plain grinding machine. As the output required in a shop of moderate size would be sufficient to keep a grinding machine fully employed, the machine would be set up for this job. An operator, after becoming accustomed to this work, can judge as to the size required by the reading of the micrometer dial on the machine, which would reduce the number of trials required in the internal gage. He would, therefore, be in a position to fill the requirements for a bill of bolts in a satisfactory manner. The end for threading could be ground to the desired size during this operation and while the surface would be tapered, no trouble should be encountered when threading.

Another practice would be to rough turn the body and also the end for the desired thread size, and then place the bolts in stock. When removed from stock the bolts would be ground as described above. This practice would reduce the amount of grinding and, as an offset, increase the cost of rough turning.

Boring Machines.—The advantages of the No. 45 horizontal boring machines are explained, and a number of installations shown in the broadside entitled "Big Advantages of the G. & L. Method," which has been prepared by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis.

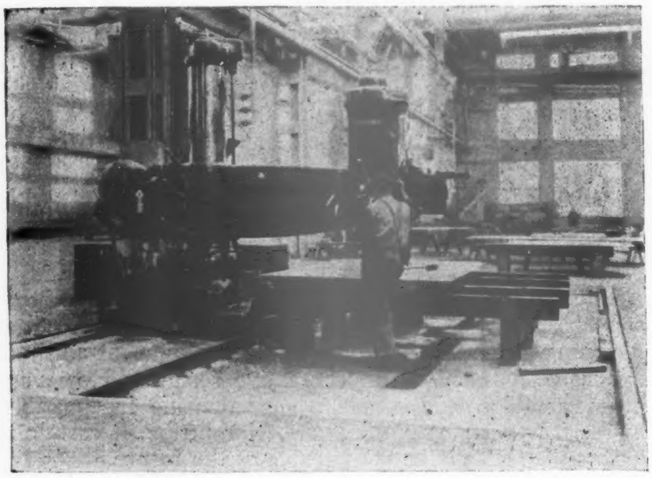
Valves.—A number of new valves, gages and appliances are among the line of pop safety and relief valves, gages, and kindred locomotive and powerplant specialties described and illustrated in Catalogue 28 which is being distributed by the Ashton Valve Company, 161 First Street, Cambridge C, Boston, Mass.

Paducah Repair Shop Operation Meets Expectations

Description of the boiler, blacksmith and other shops not in the machine and erecting shop building

By Lee Robinson
Shop Engineer, Illinois Central, Chicago

Part II



A 7-ft. radial drill in the boiler shop, mounted on rails

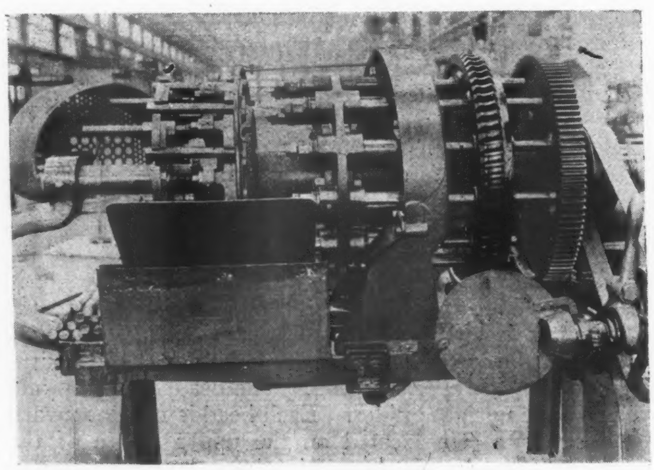
THE boiler shop is 624 ft. long and 166 ft. wide with an erecting bay on one side and a machine bay on the other, each of equal depth. The two center bays of this building are elevated above the balance of the building, providing a riveting tower for handling boilers vertically in the 26-ft. gap riveter. The traveling crane equipment in this shop consists of one 75-ton gap crane on the erecting side, two 15-ton cranes on the machine side and a 25-ton crane in the tower portion of the building. This crane is operated by remote control from the platform of the gap riveter but also has an operator's cage on the crane with dual control. The equipment is shown in the first table.

A special mounting of a 7-ft. radial drill used for drilling sheets and plates for locomotive fire boxes is illustrated. The drill is mounted on a movable carriage which is operated by electric motor, permitting quick movement of the entire machine on the rails which extend the full length of the depressed pit in which the machine operates. The machine is held in place at any location by air clamps with control placed for the convenience of the operator. Such an arrangement permits handling work of this nature quickly by moving the machine along the track to reach all portions of the sheets being drilled, rather than moving the sheets to keep within the range of the machine.

Another illustration shows an unusual multiple-spindle staybolt drilling machine. The design of this machine is such that the spindles are mounted and operated on a circular fixed head in a horizontal position, while the staybolts are handled in a revolving fixture which stops opposite each spindle for the hole to be

Boiler Shop Machines and Equipment

Machine	Motor
241—1—Bar cutter, general work......	1—7½ hp.—a.c.
242—1—McCabe Pneumatic flanging machine	....
243—1—Pneumatic flanging clamp, 10 ft.	....
244—1—Hydraulic flanging press, 2,100 tons	....
245—1—Plate heating furnace and blower, 12 ft. by 15 ft..............	1— 10 hp.—a.c.
246—1—Hydraulic flanging press—Sectional, 100 tons	....
247—1—Plate heating furnace and blower, 7 ft. by 8 ft................	1— 10 hp.—a.c.
248—1—Face plate, 12 ft. by 15 ft.....	....
250—3—Metal saws, 6 in. by 6 in.....	3— 1 hp.—a.c.
251—1—Staybolt machine, 6 spindles....	1— 10 hp.—a.c.
253—1—Staybolt drill, 12 spindles......	1— 5 hp.—a.c.
255—1—Horizontal punch, 20 in........	1—7½ hp.—a.c.
257—1—2-spindle drill, 20 in..........	1— 2 hp.—a.c.
258—1—Radial drill—Boiler plate work, 7 ft.	1— 25 hp.—main drive a.c. 1— 5 hp.—power traverse a.c. 1— ¾ hp.—comp. pump a.c.
259—1—Plain radial drill, 3 ft.........	1— 10 hp.—a.c.
260—2—Dbl. floor grinders, 18 in. by 3 in.	2— 5 hp.—a.c.
261—1—Reach stake riveter (Hydraulic), 30 tons, 18 in. gap by 84 in..	....
262—1—Gap bull riveter (Hydraulic), 200 tons, 20 ft................	....
263—1—Bending roll, 20 ft. by 1⅛ in..	1— 60 hp.—main drive a.c. 1— 25 hp.—hoisting motor a.c.
264—1—Vertical punch—single, 24 in...	1— 10 hp.—a.c.
265—1—Vertical shear—single, 24 in....	1—7½ hp.—a.c.
266—1—Vertical punch—single, 60 in...	1— 10 hp.—a.c.
267—1—Vertical shear—single, 60 in...	1—7½ hp.—a.c.
268—1—Rotary bevel shear, No. 3......	1— 10 hp.—a.c.
269—1—Plate planer, 20 ft. by 1½ in...	1— 20 hp.—a.c.
270—1—Single punch, 48 in............	1— 10 hp.—a.c.
271—1—Bending roll, 6 ft.............	1— 5 hp.—a.c.
...—1—Superheater-unit grinder—Pneumatic	....



Multiple-spindle staybolt drilling machine

drilled to a greater depth by the succeeding twist drill.

The use of the high-speed circular cold saw for cutting off rough ends of flues greatly reduces the time and also gives a better finish than was obtained with the old rotary knives. All the welding of boiler tubes at Paducah shops is performed on the electric welder illustrated. This method of welding has been found more rapid and the costs compare very favorably with the methods formerly employed.

Blacksmith Shop Has Modern Equipment

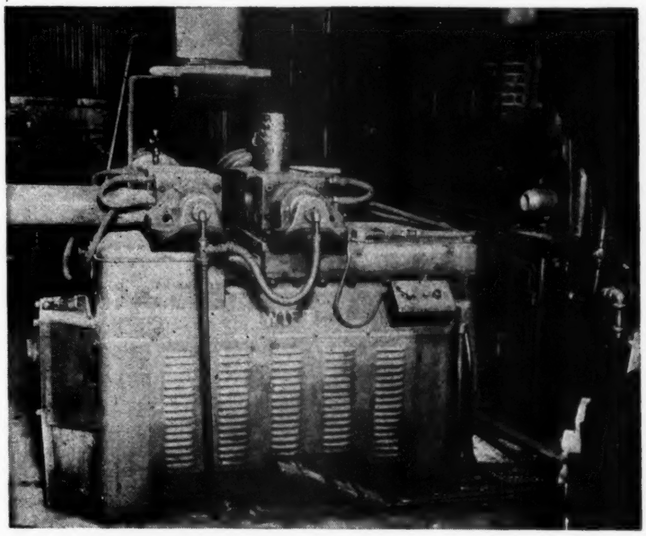
The blacksmith shop is 84 ft. wide by 46 ft. long and is provided with a 10-ton overhead traveling crane. All steam lines and hydraulic pressure lines are carried in a concrete tunnel through the center of the shop, with laterals to the various machines and tools. Pillar cranes electrically operated and ranging from 2 to 10 tons in capacity serve the steam hammers. A battery of twelve 10,000-gal. oil tanks is located underground on the west side of the building and the hydraulic system of handling oil to the furnaces and forges is used.

An auxiliary welding department is maintained in this shop where also are located two oxygraph cutting

Equipment in the Blacksmith Shop

Item No.	No. units	Machine	Motor
78	1	Heavy duty drill, 24 in.	1— 7½ hp.—a.c.
206	1	Steam-hydraulic forging press, 1,000 tons	
207	1	Dbl. forging furnace and blower, 7 ft. by 10 ft.	1—15 hp.—a.c.
208	1	Steam hammer, 5,000 lb.	
208a	1	Forging furnace and blower, 5 ft. by 8 ft.	1— 5 hp.—a.c.
209	2	Forging furnaces and blowers, 3 ft. by 4 ft.	2— 5 hp.—a.c.
210	1	Steam hammer—frame work, 3,600 lb.	
211	2	Annealing furnaces and blowers, 6 ft. by 16 ft.	2—15 hp.—a.c.
212a	1	Carbonizing furnace and blower, 4 ft. by 6 ft.	1— 5 hp.—a.c.
212b	1	Carbonizing furnace and blower, 2 ft. 6 in. by 4 ft.	1— 5 hp.—a.c.
213	1	Forging machine, 5 in.	1—30 hp.—a.c.
214	1	Forging furnace and blower, 2 ft. by 6 in.	1— 5 hp.—a.c.
218a	1	Steam hammer for tool-dressing work, 300 lb.	
218b	1	Steam hammer, 2,500 lb.	
219	1	Steam hammer, 1,500 lb.	
220	2	Steam hammers, 1,100 lb.	
221	1	Power hammer, 300 lb.	1—10 hp.—a.c.
222	1	Power hammer, 150 lb.	1— 7½ hp.—a.c.
223,224	2	Heating furnaces with blower, 3 ft. by 5 ft.	2— 3 hp.—a.c.
226	1	Hydraulic flanging press (sectional), 100 tons	
227	1	Heating furnace with blower, 5 ft. by 8 ft.	1—10 hp.—a.c.
228	1	Bolt heading machine, 2 in.	1—15 hp.—a.c.
229	1	Forging Furnace and blower, No. 5 F	1— 3 hp.—a.c.
230	1	Bolt heading machine, 1½ in.	1—10 hp.—a.c.
230a	1	Heating furnace and blower, No. 4 F	1— 3 hp.—a.c.
232	2	Forging machines, 3 in.	2—20 hp.—a.c.
233	2	Forging furnaces and blowers, 18 in. by 16 in.	2— 5 hp.—a.c.
235	1	Buffalo bar cutter, heavy duty	1—40 hp.—main drive, a.c. 1—10 hp.—table drive, a.c.
235½	1	Light duty bar shear	1— 3 hp.—a.c.
260	2	Dbl. floor grinders, 18 in. by 3 in.	2— 5 hp.—a.c.
330	1	High duty bolt header, 2 in.	1— 7½ hp.—a.c.
331	1	High duty bolt header, 2 in.	1—15 hp.—a.c.
332	1	Steam hammer, 2,000 lb.	
333	1	Dbl. head bolt cutter, 2 in.	1— 5 hp.—a.c.
334	1	Dbl. head bolt cutter, 1½ in.	1— 3 hp.—a.c.
335	2	Dbl. head bolt cutters, 1 in.	2— 3 hp.—a.c.
336	1	Bar shear, 2½ in. capacity	1— 5 hp.—a.c.
338	1	Punch, dbl., 20 in.	1—15 hp.—a.c.
339	2	Forging furnaces and blowers	2— 3 hp.—a.c.

High-speed cold saw for cutting off tubes and flues



The modern electric flue-welding machine in operation

machines for cutting shaped parts from solid stock by oxy-acetylene gas.

The 1,000-ton steam-hydraulic press, shown in one of the photographs, represents the latest practice in blacksmith-shop equipment for making large forgings, and handles with ease the quantity of work which it would otherwise require several large steam hammers to do. The pressing or squeezing action eliminates the noise and vibration which accompanies steam-hammer operations and produces a highly satisfactory quality of work.

The two car-bottom annealing furnaces shown in one of the illustrations handle practically all of the large pieces requiring heat treatment. These furnaces, as well as a number of the smaller heat-treating furnaces are fully equipped with automatic temperature control and recording instruments.

The oxygraph machine, of which there are two installed in the blacksmith shop, is a good example of the many labor-saving devices with which the shops are equipped. These machines, in connection with a heat-treating furnace, permit a large amount of irregular shapes to be cut out which formerly it was necessary to form by forging. This practice has been developed to the point that many articles can be cut to size and used without machine finishing, and when finish is necessary the amount of stock to be removed is very small.

Tank and Paint Shop

The tank and paint-shop building is 100 ft. wide by 624 ft. long. The paint-shop section has six tracks and is 294 ft. long and the tank shop action is 330 ft. long. The two sections are divided by a steel frame, corrugated-iron partition. The upper section of the partition is hinged at the top and can be swung up against the roof trusses, permitting the 50-ton overhead gap crane to transfer tenders from the tank side to the paint

side. All work on tender trucks, cisterns and frames, as well as on steel cabs, is performed in this shop.

A 1,000-ton steam hydraulic press and a forging furnace in the Paducah blacksmith shop

Tools in the Tender Shop

No. units	Machine	Motor
1	Upright drill, 42 in.	1—2 hp.—a.c.
1	Bending roll, 12 ft.	1—22 hp.—a.c.
1	Combination punch, shear and bar cutter	1—5 hp.—a.c.
1	Punching and spacing table, 10 ft. by 33 ft. by ½ in.	1—5 hp.—a.c.
1	Quick work rotary shear	1—15 hp.—a.c.
1	Radial drill plain, 5 ft.	1—10 hp.—a.c.
1	Upright drill, 24 in.	1—2 hp.—a.c.
1	Combination car axle and journal turning lathe	1—15 hp.—a.c.
1	Car wheel borer, 48 in.	1—15 hp.—main drive a.c. 1—5 hp.—hoist a.c.
1	500-ton wheel press, 54 in.	1—15 hp.—a.c.
1	Wheel turning lathe, 42 in	1—15 hp.—main drive a.c. 1—10 hp.—tail stock a.c.
1	Dbl. floor grinder, 18 in. by 30 in.	1—5 hp.—a.c.
2	Face plates, 8 ft. by 19 ft.	....

The paint and carpenter shop is 50 ft. wide by 171 ft. long, the paint section being 50 ft. long and the carpenter shop 121 ft. long. Local storage for paints, oils and varnish and stencil work is taken care of in the paint shop.

The carpenter shop handles wood cabs, pilots, running board and tender decking.

The pipe, tin, copper-smith and sheet-metal work, air-brake and air-pump work and electrical maintenance work is performed in a building 67 ft. wide, divided into three rooms 170 ft., 72 ft., and 73 ft. long, respectively.

The store department facilities consist of a two-story main storehouse building with basement under the entire building, 66 ft. wide by 296 ft. long, and an oil and paint storage building 66 ft. by 147 ft., with a 177-ft. covered platform between them.

Tools in the Carpenter Shop

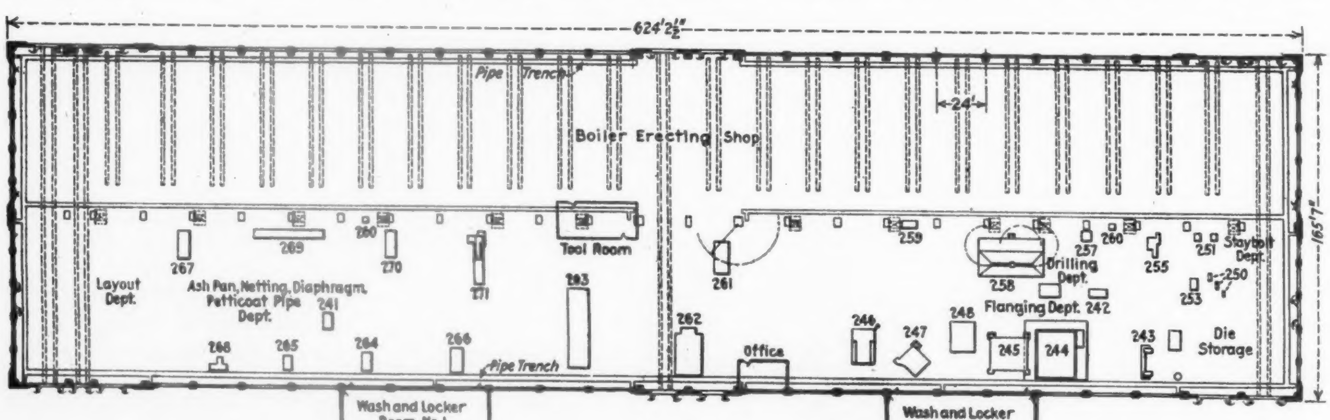
Machine	Motor
1—Band saw, 36 in.	1—5 hp.—a.c.
1—Jointer and planer, 12 in.	1—5 hp.—a.c.
1—Vertical mortiser and boring machine (medium)	1—5 hp.—a.c.
1—Universal woodworker, light	1—2 hp.—a.c.
1—Upright drill, 25 in.	1—3 hp.—a.c.

Equipment in the Pipe and Tin Shop, the Air-Brake Shop and the Electrical Department

No. units	Machine	Motor
	PIPE AND TIN SHOP	
1	Power gap shear, 15 in. gap by 96 in. by No. 10 gauge	1—5 hp.—a.c.
1	Power roll, 8 ft. by No. 10 gauge	1—7½ hp.—a.c.
1	Power press, No. 7 A	1—5 hp.—a.c.
1	Hand brake, 8 ft. by No. 16 gauge	....
1	Power punch	1—1½ hp.—a.c.
1	Pipe threading machine, 6 in.	1—5 hp.—a.c.
1	Pipe threading machine, 2 in.	1—1 hp.—a.c.
1	Circular cold saw—pipe cut-off	1—10 hp.—a.c.
1	Pipe bending machine, 3 in.	1—20 hp.—a.c.
	AIR-BRAKE SHOP	
1	Engine lathe, 22 in. by 10 ft.	1—10 hp.—a.c.
1	Engine lathe, 16 in. by 9 ft.	1—5 hp.—a.c.
1	Vertical turret lathe, 42 in.	1—15 hp.—a.c.
1	Forcing press, 75 ton	1—5 hp.—a.c.
1	Upright drill, 20 in.	1—3 hp.—a.c.
1	Micro grinding machine	1—5 hp.—a.c. 1—2 hp.—a.c.
1	Foster semi-automatic valve grinder	1—2 hp.—a.c.
1	Dbl. floor grinder, 14 in. by 2 in.	1—3 hp.—a.c.
1	Arbor press (Hand operated) No. 3 R	....
1	Air pump test rack	....
1	Reversing gear test rack	....
1	Control valve test rack	....
1	Engineer's valve test rack	....
1	Triple valve test rack	....
1	Pump governor and feed valve test rack	....
1	Fire door opener test rack	....
1	Bell-ringer test rack	....
	ELECTRICAL DEPARTMENT	
1	Engine lathe, 18 in. by 11 ft.	1—5 hp.—a.c.
1	High speed lathe, 12 in. by 6 ft.	1—1½ hp.—a.c.
1	Crank shaper, 16 in.	1—3 hp.—a.c.
1	Small sensitive drill	1—1½ hp.—a.c.
1	Radial drill, 36 in.	1—7½ hp.—a.c.
1	Dbl. floor grinder, 14 in. by 2 in.	1—3 hp.—a.c.

The storehouse is equipped throughout with steel shelving, has two 5-ton hydraulic elevators for handling material between floors, and a package conveyor for small packages. In the oil house is a modern oil handling system of oil tanks and self-measuring oil pumps. The paint-storage section is supplied with mixing machinery and an overhead trolley system for handling material.

There is also a separate building, 84 ft. by 193 ft., for the storage of iron and steel. The flue shop, occupying



General arrangement of the boiler shop

a space 84 ft. by 54 ft., is located in one end of this building.

Two water-type flue cleaners are located just outside of the building at one end of the flue shop and under the main yard craneway. An opening in this end of the building permits the flues, when cleaned, to be rolled directly to racks inside of the shop, from which they are handled through the machines.

The brass foundry is 67 ft. by 98 ft. in size. In the building there is a foundry floor, 67 ft. by 66 ft., a pattern shop, 25 ft. by 32 ft., and a pattern storage room, 42 ft. by 32 ft.

Equipment in the Flue Shop, the Pattern Shop and the Brass Foundry

FLUE SHOP

No. units—Machine	Motor
1—Electric flue welder, 6 in. capacity	1— 7½ hp.—a.c.
2—Ryerson pit type flue cleaners	2—25 hp.—a.c.
1—Pneumatic flue welder	....
1—Pneumatic flue swedger, 2 in.	....
1—Pneumatic flue swedger, 6 in.	....
1—Special flue welding furnace and blower	1— 3 hp.—a.c.
1—Circular flue cut-off saw	1—10 hp.—a.c.
1—Safe end flue lathe	1— 1 hp.—a.c.

A brass foundry is 67 ft. by 98 ft. in size. In the building there is a foundry floor 67 ft. by 66 ft., a pattern shop 25 ft. by 32 ft., and a pattern storage room 42 ft. by 32 ft.

PATTERN SHOP

1—Universal circular saw, 7 in	1— ½ hp.—a.c.
1—Small Band saw, 16 in.	1— ⅓ hp.—a.c.
1—Wood turning lathe, 6 in.	1— ½ hp.—a.c.
1—Bench jointer, 6 in.	1— ⅓ hp.—a.c.
1—Disc grinder and sander, 16 in.	1— ⅓ hp.—a.c.

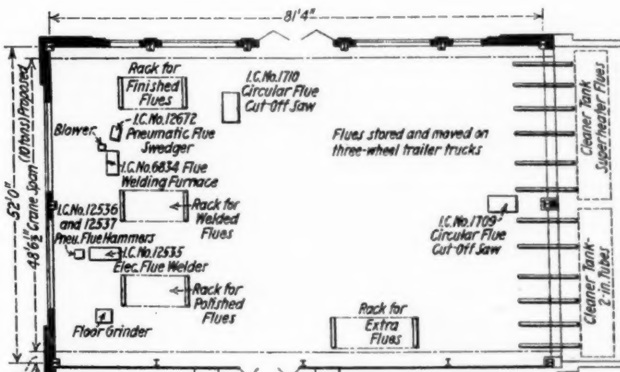
BRASS FOUNDRY

1—Dbl. floor grinder, 18 in. by 3 in.	1— 5 hp.—a.c.
1—Rotary brass melting furnace, 1,000 lb. capacity, complete with blower and oil pump	1— ¾ hp.—furnace a.c. 1— ¾ hp.—oil pump a.c. 1—5 hp.—blower a.c.

A Modern Power House

The power house, which completes this group of buildings, is a two-story building, 91 ft. wide by 244 ft. long, divided into a boiler room, 91 ft. by 146 ft., and an engine room, 91 ft. by 98 ft. In the boiler room are located eight 864-hp. water-tube boilers set in two rows of batteries facing a central aisle. Each boiler is equipped with traveling chain-grate stokers with a grate area of 174 sq. ft. and a 100-deg. superheater. Recording meters on each boiler show the pounds of steam per hour, temperature of uptake gas, rate of flow of uptake gas, CO_2 recorder and three-point indicating draft gage.

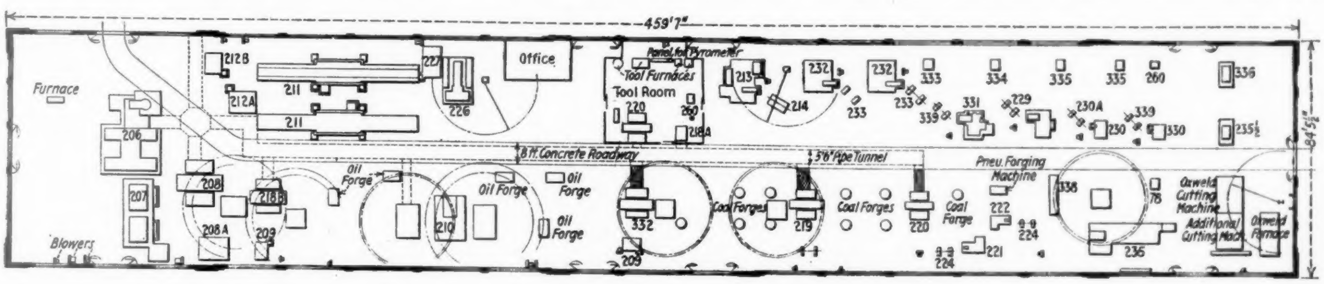
Recording meters are also placed on the boiler feed lines for measuring the water fed to the boilers. Each battery is served by a reinforced-concrete chimney 12 ft. in inside diameter by 265 ft. high. The boilers operate on natural draft. Coal is received in a concrete hopper at the southwest corner of the building; reciprocating feeders handle the coal to cross drag conveyors which deposit the fuel in the main conveyors, which are of the pivoted-bucket type. These continuous bucket conveyors elevate the coal to the overhead bunkers, from which it flows by gravity to the stoker hoppers. Automatic spout swingers keep these stoker hoppers filled to capacity at all times. There are duplicate units of all coal-handling machinery. The boiler room has space for the installation of two additional boilers. Cinders are handled in the basement by means of two-



The flue shop

wheel, ball-bearing push carts. The cinders are dumped directly from the ash hoppers on the boilers into the push carts and wheeled to an elevator located on the east side of the building, which automatically dumps them into an overhead storage tank from which they can be handled by gravity into cinder cars. After dumping, the elevator returns the ash cart to the basement floor level.

In the engine room on the main floor are located one 5,000-ft. two-stage duplex air compressor driven by a unaflow engine; one 3,000-ft. two-stage duplex-engine-driven air compressor, and one 3,000-ft. two-stage synchronous-motor-driven air compressor. There is also a three-cylinder hydraulic pumping engine which, with the accumulator located in one corner of this room, furnishes pressure for all hydraulic machinery in all of the shops. A pressure of 1,500 lb. is maintained in this hydraulic system. There is space reserved in the engine room for an additional 5,000-ft. air compressor. On a balcony of this room is the main distribution switch board for the entire plant, consisting of 23 panels with push-button control. The switches, bus bars, etc., are located in the basement.



Arrangement of equipment in the blacksmith shop

In the basement, which is really the ground floor, are also a motor-driven and a turbine-driven underwriters' centrifugal fire pump, each having a capacity of 1,500 gal. per min. Boiler feed water is handled by two synchronous-motor-driven, and one steam-turbine-driven

three-stage centrifugal boiler feed pump with a capacity of 350 gal. per min., and a steam-driven 14-in. by 8-in. by 18-in. duplex pump is provided for emergency boiler feed and general service, all of which are in the engine-room basement. Air cleaners are provided on the intakes to the air compressors and a sump under the basement floor conserves all condensation returns from the heating system, air compressor jacket-cooling water, and overflow water used for general purposes. All of this water is reused for boiler feeding. There is also a separate pump for collecting return water from the hydraulic machines. Water is handled from

Two-car-bottom annealing furnaces equipped with automatic temperature control

these sumps by means of vertical motor-driven sump pumps automatically controlled by floats. A 10-ton overhead traveling crane serves the engine room.

A main material midway forms a general separation between the locomotive and car departments. This midway is 80 ft. wide and is served by a craneway 2,510 ft. long, on which operate two 20-ton traveling cranes. There are two lateral craneways connecting to this main runway, one to the east serving the tank shop and one to the west which will eventually serve the car shop.

Building of Main Car Shop Deferred

At the present time, the car-department facilities consist of a wood mill, 84 ft. wide by 316 ft. long, a wheel shop, 73 ft. by 170 ft., a paint, stencil and waste-vat building, 30 by 60 ft., a finished lumber shed and eight car-repair tracks. The construction of the main unit, the car repair shop, and the reclamation shop, together with eight additional repair tracks, has been deferred for the present.

One of the oxygraph mechanical cutting torches in the blacksmith shop

The side-wall window arrangement and roof skylight construction, as described in reference to the machine and erecting shop, applies to all shop buildings, as does also the heating system of unit heaters. All shops have wood-block floors, except the flue shop, paint shop and brass foundry, and are piped for compressed air. A central generating plant supplies oxygen and acetylene gas to all shop buildings requiring this service. Socket-plug connections are provided in all buildings for operating portable electric tools and for extension-light cords. Commercial gas is piped to the tool-dressing department in the blacksmith shop, to the machine shop for tire heating, and to the pipe and tin shop for brazing and small heating furnaces.

Automatic temperature regulators with recording instruments are provided on all annealing and heat-treating furnaces. There are five portable electric-welding machines and six portable electric rivet heaters in the plant.

A material delivery system is operated on regular schedules over prescribed routes and supplements the service rendered by overhead cranes. This system utilizes three electric crane trucks, two low-lift trucks, two high-lift trucks, three gas tractors, one electric tractor and 100 trailers. Skids are used with the low- and high-lift electric trucks to the fullest extent to eliminate extra handling of material.

Concrete roadways, of which there are 16,300 sq. yds., connect all shop buildings, permitting rapid handling of material by the delivery system. They are also very effective in keeping the entire shop premises in a clean and orderly condition.

The administration building is located at the main entrance to the property, giving ready access from the city streets and serving both the locomotive and car departments with equal facility. This building provides private offices for the shop superintendent, general locomotive foremen, general car foremen and the division master mechanic, together with a general office for all clerical work of both the shop superintendent and master mechanic by one office organization. All of these offices are located on the first floor. The second floor is given over to the division storekeeper and his force, and also provides for a large assembly room for shop-craft meetings. Both manual and automatic telephone switch boards are installed in rooms on this floor. A basement under the entire building gives ample space for file storage and also contains employment bureau offices. All office furniture throughout the entire plant is of metal construction.

The engineering, design and construction of the plant was carried out under the supervision of A. F. Blaess, chief engineer and F. R. Judd, engineer of buildings. All mechanical features were handled by R. W. Bell, general superintendent motive power, Lee Robinson, shop engineer and C. A. Shaffer, general supervisor of shop machinery.

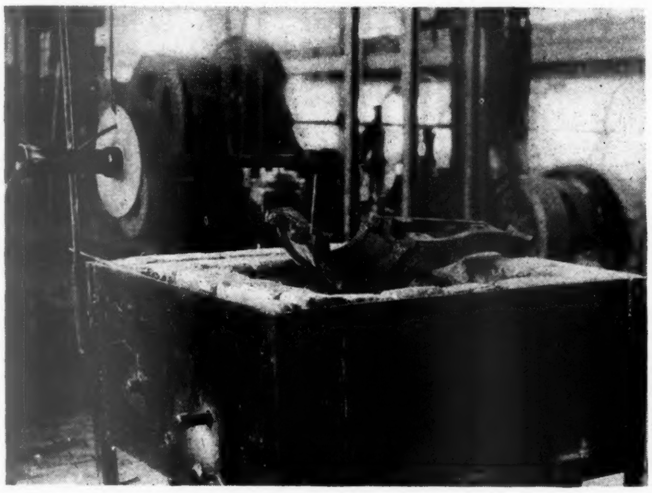
The Pennsylvania following a conference between officers of the road and representatives of employees has advanced the pay of shopmen to the extent of making an increase of $3,500,000 annually in the pay rolls. The increase inures to the benefit of about 36,000 employees scattered throughout the system. The basic rate for the principal groups is advanced from 78 cents an hour to 82 cents. Carmen receive an increase of four cents, from 70 cents to 74 cents, and the car cleaners, who received an increase recently of two cents an hour, are granted an additional advance of one cent.

Electric Welding Cast Iron

By I. W. Eger

System Welding Supervisor, D. & R. G. W., Denver, Colo.

THE illustration shows a method of electric welding cast iron developed at the Burnham shop of the Denver & Rio Grande Western (Denver, Col.). A crane from which the carbon holder is supported is made by taking a ¾-in. pipe, 10 in. long and tacking it to the side of the forge. A ½-in. rod, about 5 ft. long, is bent to a right angle at one end so that when the rod is inserted in the pipe on the forge, the bent portion will be about 4 ft. above the top of the forge. This will form a crane for the carbon holder as the



Method of supporting a carbon arc holder when welding cast iron in a forge

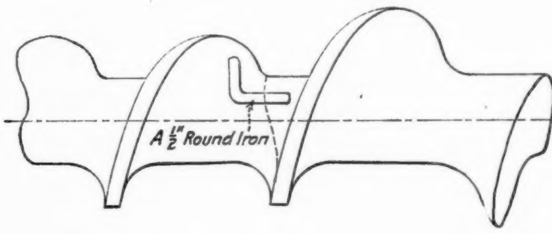
rod can be turned to any position in the socket. The carbon holder is suspended from the crane by the use of a piece of bellrope, the lower end of which passes through a hole in the carbon-holder disc guard. A handy device is thus provided for welding at the forge while the material is heated to the proper temperature. Heretofore, cast iron welding on the D. & R. G. W. has not spread much farther than the foundry, because of the fact that the welder had no convenient way to preheat the casting and hold the carbon electrode.

By the use of this device, we have been able profitably to weld such material as cellar boxes, the original low cost of which precludes much money being spent in repairs. In doing this work, the broken pieces, which are of thin metal, are set up and tacked together. After the piece has been preheated to a red heat, it is welded from both sides, preferably while the piece is in the fire. If a carbon backing plate is used, this also should be preheated in order to avoid the possibility of chilling. In welding cast iron, it should be borne in mind that it is not the excess carbon that makes the metal hard, but the lack of carbon in a free state that causes the fine white structure in a chilled casting. When cast iron is chilled, the carbon is absorbed. If a weld turns out to be hard the surface is ground off to the soft interior so that it can be machined. Holes may be plugged up and, if allowed to cool slowly, can be drilled or machined.

Work can be done with this method at a cost of about $1.25 per hour as against other methods at more than twice this cost. The carbon arc is also faster and cooler for the operator. A common ¼-in. cast iron filler rod is used in this operation.

Repairing a Stoker Conveyor Screw

THERE are occasions when a stoker-equipped locomotive comes into the shop on which the conveyor screw of the stoker will be found to be badly cracked or nearly broken in two. Such cracks usually are found within the crushing zone. When a defect of this nature



Sketch showing the method of making repairs to a cracked stoker conveyor screw—The dotted line indicates a possible crack

is discovered, especially before a complete break has occurred, satisfactory repairs can be made by reinforcing the screw at the crack by the following method:

A number of pieces of ½-in. round bar are cut and bent at right angles, as shown on the sketch, with one leg equal to two-thirds of the distance from the center of the bottom flat of the screw to the edge of the flight. The other leg should be made long enough so that it extends from the flight 1½ in. or 2 in. beyond the crack. After the conveyor screw has been thoroughly cleaned, the bar of ½-in. round is welded over the crack, as shown. The vertical leg of each piece of bar is welded to the section of the flight next to the crack. A sufficient number of these reinforcing bars must be applied to cover the entire length of the crack.

The repairs just described have been made at various times on conveyor screws that handle hard grades of bituminous coal, and are said to have given as good service as a new screw. As a rule, these repairs, even with bad breaks, require only five to six hours and are considerably cheaper than the cost and application of a new conveyor screw.

Unit Heating.—A new heater bulletin, published by the L. J. Wing Mfg. Company, 154 West Fourteenth street, New York, outlines briefly the history and development of unit heating and shows the essentials necessary for good factory heating and how the Wing method meets them. The bulletin also contains full description, engineering data and information on Wing Featherweight unit heaters.

The Reader's Page

Are There Others in the Same Predicament?

BUFFALO, N. Y.

TO THE EDITOR:

At an air brake convention held in Chicago, a few years back, Commissioner Frank McManamy, in an address stated that one of the causes of air brake trouble resulted from the fact that as soon as a man became familiar enough with the air brake to make repairs promptly and economically, as well as to acquaint others with its mysteries, he was taken from this work and made into an enginehouse foreman. Two men sitting together at that meeting expressed themselves as being in that predicament. Both felt that they were out of place. Their interest in the air brake was borne out by the fact that they were supervisors in another department, but still attended the air brake conventions.

I would like to read the opinions of some of your readers on this subject.

A SPECIALIST.

Valve Setting Comments Misleading

PROCTER, MINN.

TO THE EDITOR:

I believe the article "Getting Back to Fundamentals on the Chicago & Alton," which appeared in the December issue of the *Railway Mechanical Engineer,* page 697 to be somewhat misleading with respect to methods used to obtain variable lead with Walschaert valve gear.

Under the subhead "Variable Lead for Walschaert Gear," the writer of the article says: "The gear is laid out the same as for constant lead. When the length of the eccentric rod and the correct eccentric circle is obtained the position of the eccentric pin is advanced or retarded on the original eccentric circle to provide the desired lead with the link block in the bottom of the slot. Then, as the link block is brought towards the center of the link, the lead is decreased to that obtained by the ordinary valve setting." He says further that the valves on the Chicago & Alton are set to obtain 1/16 in. lead in center and ¼ in. in corner positions; that with this setting the engine has an abundance of lead for starting train, and that lead decreases as the engine is hooked up.

I cannot see how this result is obtained without changing the ratio of the combination lever. My experience with the Walschaert gear has taught me that the only movement of the valve when the link block is in the center of the link is the motion transmitted by the crosshead through the combination lever. Consequently any change in crank-arm position can not affect the valve movement when the link block is in the center of the link.

The only way the results mentioned could be accomplished would be by changing the ratio of the combination lever and advancing the crank arm to give the desired lead in the corner.

On the Duluth, Missabe & Northern we give our Walschaert gear engines variable lead in the following manner. We retard the crank arm to give 1/16 in. lead in forward corner and ¼ in. lead in the center, thus resulting in 7/16 in. lead in the corner when the engine is reversed. When retarding the crank arm we also lengthen it in order to maintain the same crank-arm pin circle (see the diagram) in order to avoid reducing the original maximum valve travel.

CHARLES W. HARRIS,
Foreman, Mechanical Department,
Duluth, Missabe & Northern.

Lead of Locomotive Valves

SHREVEPORT, LA.

TO THE EDITOR:

In an article, "Getting Back of Fundamentals," in the December issue of the *Railway Mechanical Engineer,* mention is made of the setting of the Walschaert valve gear on the Chicago & Alton. The author states that engines equipped with this gear are now being set with variable lead. The gear is laid out the same as for constant lead. When the correct eccentric circle and length of eccentric rod is obtained, the eccentric pin is advanced or set back on the original eccentric circle to provide the desired lead at full gear, which is ¼ in. in full gear and 1/16 in. with the link block in the center of the link. According to this, it would be necessary to proportion the combination lever for 1/16 in. lead.

With this setting the locomotive would have plenty of lead for starting a train, and as the speed is increased and the reverse lever hooked up, the lead would be decreased.

It is claimed that this change in valve setting makes a smoother operating locomotive, eliminating much of the pounds on shoes and wedges and wear on pins and braces which is caused by an excessive amount of lead at a short cut-off operating at high speed.

It has generally been taught that a large amount of lead was necessary at high speed to bring the reciprocating parts to rest and begin the return stroke, the steam acting as a cushion against the piston to check the momentum of the piston, crosshead and main rod.

From ordinary reasoning it is seen that an excess of lead would act as a detriment instead of an advantage.

Assuming that a locomotive is set with ¼ in. of constant lead, with the reverse lever in full gear in starting a train, this much lead is desirable because an abundance of steam is assured for the beginning of the stroke. With the reverse lever in this position, the cut-

off occurs at approximately 85 per cent, or, in other words, steam is admitted to the cylinder for almost the entire length of the stroke. But with the reverse lever hooked up and the locomotive operating at high speed, a great amount of useless force is imparted to the main rod and, in turn, to the driving boxes, just before the pin reaches the dead center, because of the high compression and because the steam is admitted to the cylinder considerably before the pin reaches an angle where useful work may be performed.

This event, of course, is known as pre-admission and would occur about 1⅞ in. before the completion of the stroke. With the reverse lever in this position, cut-off would occur at about 25 per cent of the stroke, which means that expansion has already taken place with a consequent reduction in cylinder pressure on the opposite side which, with the aid of the accumulated momentum of the locomotive, must force the pin nearing the dead center at a position in the crank circle to perform useful work against the high compression and steam pressure admitted by the lead.

It is claimed that by this change of valve setting on the C. & A. an unexpected tractive force was developed by fourteen locomotives under dynamometer car test, which permitted an increase in tonnage rates of from 20 to 25 per cent.

There is no doubt but that there is a great amount of wasted energy when the engine is at or near each dead center on a locomotive which has an excessive amount of lead in the running cut-off, and also an unnecessary amount of wear on the entire running gear.

Possibly a little discussion of this subject would bring out more and better ideas and promote progress.

B. J. BABIN,
Machine Foreman, Kansas City Southern.

Opportunities of a Shop Specialist

MECHANICVILLE, N. Y.

TO THE EDITOR:

Recent articles published in the readers' page of the *Railway Mechanical Engineer,* refer to specialists in railroad shops being taken from their chosen branch of work and advanced to supervisors over numerous classes of employees. Some of those chosen are capable of stepping into a supervisory position and are able to grasp the necessary points in all matters that come under their direction. These men usually possess the necessary qualifications required to assume leadership and carry out organization in such a manner that their progress is continuous. They would, no doubt, move along regardless of what work they were engaged in.

Other supervisors are chosen, however, who do not possess executive ability and are not always capable of exercising good judgment in supervision. The fact that a man will study hard to master a subject on which he is working, may not be with a view to advancement. He may be desirous of having a thorough understanding of his branch of work to be able to make rapid repairs economically and to be able to give a clear explanation of operation, or the cause of failure of operation. He may be able to make improvements in repair practices and overcome difficulties that present themselves in his line of work. What are apparently mysteries to others are common-sense problems to him. He quickly masters a difficult situation that often attracts the attention of some one higher in authority. His immediate superior, when questioned about his ability, will state his qualifications. He is offered a supervisory position and, while he does not care to leave his chosen work, he will not decline the offer and be considered as "dead wood". He will take the position and will now be in charge of a number of men in different classes of work, some of which he is not familiar with. Some of the men under his supervision, more or less jealous, will not consider him capable and he will be allowed to take many false steps, when a word or two would show him his error. He may be questioned on something that he is not as familiar with as he would like to be and hesitates, wherein his troubles begin. This man is facing one of life's darkest moments. Had he been left on his own chosen work, I believe he would be worth far more to his employer, who is wasting time and money, trying to get the best results from his supervision.

Had he been given this supervisory position with the understanding that a thirty-day trial would be allowed, there would be a number of cases where men would go back to their preferred line of work. The man who is going to make the right kind of a supervisor, should be able to indicate his ability within 30 days.

My contention is that a number of specialists in their line today are worth far more in that line than is really appreciated. Certain subjects call for specialists and in most cases it is chosen work, or a man would not have tried to master the subject. Supervisors are easily enough picked from apprentice schools which today give far more extensive training and broader experience than ever before, a great deal of which the specialist has not obtained in his experience. On the other side of the question is the fact that the branch of work followed by the specialist will suffer more than is at first supposed through the loss of his service.

The officers who promote these men are surely doing the square thing by giving them the chance to advance if they can, and are to be commended for this attitude, but quite frequently, harm actually may be done all around.

A. B. MAN.

Building up Car Axle Collars by Welding

NEW HAVEN, CONN.

TO THE EDITOR:

I presented the following question at the last convention of the Master Car Builders and Supervisors Association, which was held at St. Louis, Mo., last September. I had a definite object in view, which, of course, was based on the answer. However, because the question was presented too late for consideration, the answer was held over until next year. I would like to have an answer at an earlier date, and would appreciate it very much if you would publish it on the Readers' Page.

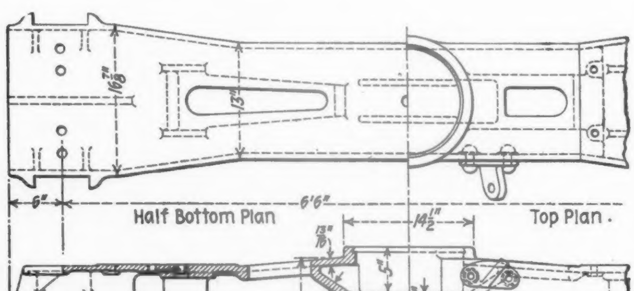
The following is the question: Is it permissible under Rule 23 to build up the collars on scrap car axle journals by acetylene welding? If, after welding, these journals meet all the gage requirements for new axles, may they be charged as new axles when applied to a car?

JAMES W. McDONNELL.

ROTARY GEAR PUMPS.—Recognizing the need among buyers for a catalogue giving complete pumping information, the George D. Roper Corporation, Rockford, Ill., has prepared and is distributing a loose-leaf catalogue, known as No. 54, in which Trahern rotary pumps having capacities of from one to 250 gallons per minute are illustrated and described. These pumps are used by the railroads in machine shops and other departments.

A Lubricated Car Center Bearing

IN the June 28, 1928, issue of the Daily Railway Age, on page 1490D121, appeared an article describing a lubricated center-bearing bolster which has been developed by the Pittsburgh Steel Foundry Corporation, Glassport, Pa. The bolster described in this article was designed for use with a center plate which serves as a reservoir for the oil, holes through the top center plate side and bottom walls permitting the oil to pass through into the center bearing recess of the bolster.



Lubricated center-bearing bolster with oil pockets in the bolster

This method of lubrication is intended for general use on all types of cars except those which are unloaded in car-dumping machines. In such cases, other provisions for storing the lubricant are necessary in order that it may not be lost when the cars are dumped.

The drawing shows the modification in the bolster structure which has been made by the Pittsburgh Steel Foundry Corporation to provide space for an oil reservoir in the bolster itself rather than in the center plate. Oil pockets are cored in the bolster at either side of, and opening into the center-bearing recess, and the center plate is cast solid. A sufficient amount of lubricant is placed in the center-bearing recess before the body center plate is dropped into place, and with the wool-felt dust and oil guard in its groove, this lubricant is sealed in place, irrespective of the position of the car.

It will be seen on the drawing that the center-bearing recess in the bolster has a depth of 5 in. and that with the center plate in the bearing, there is 1/8 in. clearance between the under surface of the flange and the top of the bolster. The dimensions also show that the wool-felt dust and oil guard, when in its recess in the bolster, projects 1/4 in. above the top of the bolster. It is thus under 1/8-in. compression when the center plate is in place.

Two cars equipped with the lubricated center-bearing type of bolster were placed in service in the Pittsburgh district in May, 1927. Early in April, 1928, these cars were inspected to determine the condition of the center plates and center-bearing recesses in the bolsters. The center plates showed no evidence of wear beyond the brightening of the skin surface on a small area at the corners of the center-plate bearings on the transverse center line of the body bolster. There was no external evidence that any of the oil had been lost. The felt oil-retaining and dust ring was still in place and functioning effectively.

ENGINE AND POWER UNITS.—The Waukesha Motor Company, Waukesha, Wis., illustrates and describes in a 20-page booklet engine and power units which, while developed during 1928, are now offered as the latest developments of their respective types. The booklet is entitled "What's New with Waukesha?"

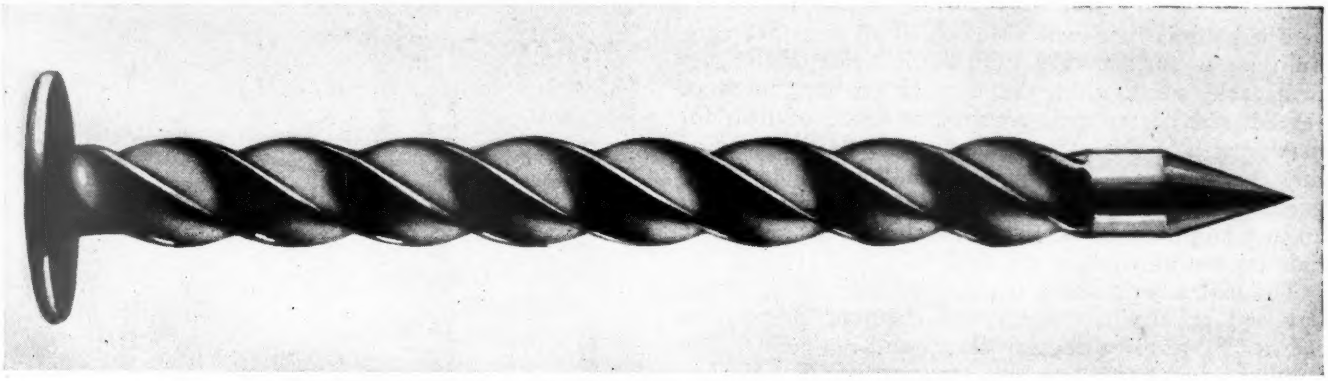
AIR COMPRESSORS.—Duplex air compressors for single stage or two-stage compression are illustrated and described in Bulletin No. 144 issued by the Pennsylvania Pump & Compressor Company, Easton, Pa. Advantages of synchronous motor drive are pointed out in this bulletin.

Screwnails for Fastening Sheet Metal to Wood

THE Parker-Kalon Corporation, 204 Varick street, N. Y., has been making experiments for some time on a nail for fastening sheet metal to wood which would not bend, back out or loosen. As a result of these experiments a nail has been patented, which is designated as the Screwnail, because it is driven like a nail and holds like a screw.

The hardened spiral thread and needle-pointed pilot of the Screwnail can be driven through much heavier sheet metal than ordinary nails, without bending. In many instances, it eliminates the necessity of punching or drilling holes in the sheet metal. The hardened spiral thread forms a thread in the metal burr and the wood which enables the Screwnail to fasten the sheet metal securely to the wood.

Laboratory tests made at Columbia University show that hardened Screwnails have over four times the holding power of ordinary nails.

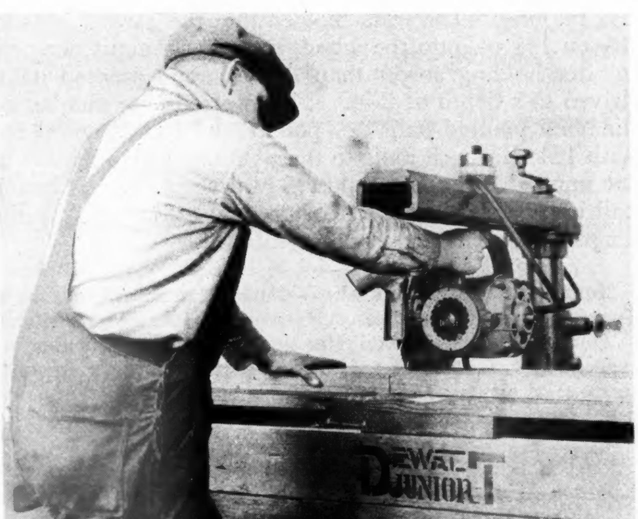


Parker-Kalon hardened Screwnails for fastening sheet metal to wood

Screwnails may be used by sheet metal workers for fastening cornices, metal ceilings, corrugated sidings and sheet metal work in general to wood and also for laying tin roofing, for fastening gutters, etc., to wood.

DeWalt Junior Woodworker

THE DeWalt Products Corporation, Leola, Pa., manufacturers of the DeWalt Wonder-Worker, have placed on the market the DeWalt Junior electric woodworker in which are incorporated the features of the Wonder-Worker, such as balanced, guided power applied to the saw in all cutting positions, instant change from cross-cutting to ripping without stopping the motor, an accurate ripping gage and dials for adjustment to any position. The motor operates from any cycle in either alternating current or direct current by plugging into a light socket. The machine will handle accurately and safely 29 distinct cutting operations, including dadoing, routing, mitering, shaping, grooving, ploughing, rabbeting, mortising, tenoning, gaining, and wood cutting operations.



DeWalt Junior fitted with a rip saw blade

By quickly attaching the necessary cutting tool, the DeWalt Junior is adapted to another cutting job. The work, which moves fast whatever the cutting operation, is handled from one side of the table, whether cross-cutting, ripping or shaping. The layout marks are always in plain view.

With a 12-in. combination cross-cut and rip saw, which is standard equipment, the DeWalt Junior rips 2-in. stock at the rate of 20 lineal ft. per min. Fitted on a wooden table 29 in. by 59 in., the machine weighs 235 lb. complete. It is compact and readily portable and can easily be carried by two men to be set up on a pair of horses or moved about on a movable truck. The machine is fitted with a roller-bearing arm.

Standard equipment includes an adjustable guard that fits down to the work and gives positive protection to the operator.

Two Convenient Small Tools

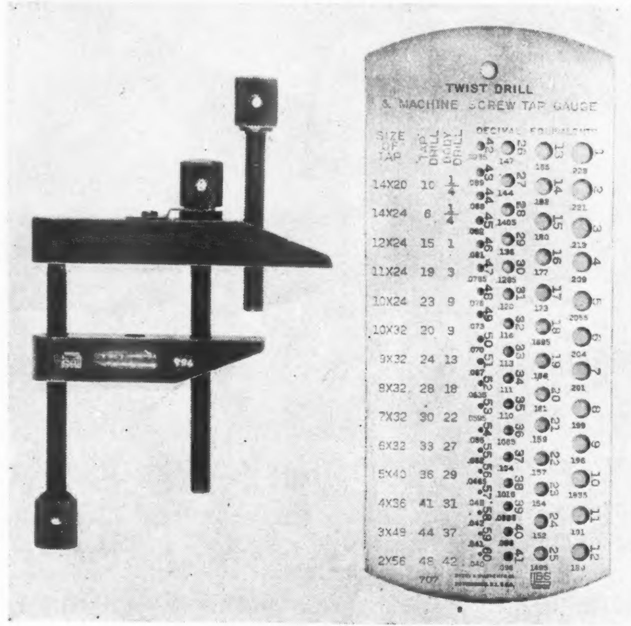
THE Brown & Sharpe Manufacturing Company, Providence, R. I., has placed on the market a compact twist-drill and machine-screw tap gage and a redesigned toolmaker's clamp. The use of the drill and screw tap gage eliminates the selection of drills by trial, since the gage indicates at a glance the correct drill to use with any common size of machine screw tap.

The gage is hardened after which all sizes are carefully tested for accuracy. On the left side of the gage is a table which gives the size of the tap, pitch of thread, size of tap drill required and size of drill for making a hole through which the outside diameter of the tap will pass. The figures beneath each hole on the gage represent the size of the drill in thousandths of an inch and the figures, 1 to 60, inclusive, near the hole indicate the number of the drill.

The toolmaker's clamp is provided with a long lower jaw and an auxiliary screw for clamping pieces that the even jaws of a regular clamp will not hold. The auxiliary screw and long jaw gives support and rigidity and prevents the pieces from slipping. The spring attachment on the adjusting screw holds the loose jaw in position at all times.

The clamp can be used with any Brown & Sharpe vee or handy block. The jaws are rounded on the ends to allow clamping under a shoulder, and the long jaw extends over the top far enough to clamp the piece. By changing the position of the screws in the jaws, the clamp can be used as a regular clamp with the added advantage of an auxiliary screw.

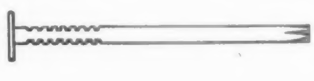
The clamp can be furnished with either a 2-in. or 2½-in. jaw opening.

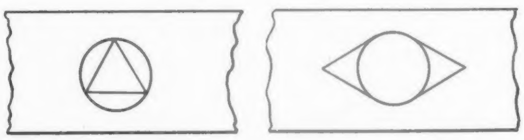


The Brown & Sharpe No. 756 toolmaker's clamp and the No. 707 twist-drill and machine-screw tap gage

Stronach Non-Splitting Nails

THE Stronach Nail Company, Union Bank Building, Pittsburgh, Pa., has placed on the market a patented nail, the two principal features of which are that it is non-splitting and has increased holding power. When a pointed nail is driven into a board, the point spreads the fibers of the wood and wedges them apart. This tends to split the board. The Stronach nail does not work on this principle, but is designed to distribute the pressure around the entire circumference of the nail and not in just two directions, as is the case when a pointed nail is used. The triangular section at the end of the Stronach nail cuts the wood fibers and punches a triangular hole ahead of the body of the nail. The size of this triangular hole is always proportional to the size of the nail body, as indicated in the illustration, and is always inscribed inside the circle which forms the cross section of the nail body. There are no void spaces around the nail in the wood, as is the case with the pointed nail.





Action of the Stronach nail and a pointed nail when driven into a piece of wood

The Pittsburgh Testing Laboratory made a comparative test to determine the holding power of a blunt diamond-pointed nail, 2½ in. long, and a Stronach nail, 2¼ in. long. The tests showed that the Stronach nails, driven 1¾ in. into the wood, had nearly eight per cent greater holding power than the diamond pointed nails, driven to a depth of 2 in. The approximate number of diamond pointed nails per pound was 106 as compared with 161 Stronach nails to the pound. This increase in the number of nails per pound in favor of the Stronach nail is because they are shorter than other nails by the length of the customary pointed end.

MODERN METAL HANDLING.—Cutler-Hammer, Inc., 195 Twelfth street, Milwaukee, Wis., photographically presents in its booklet "Modern Metal Handling Methods" a number of applications of Red Top lifting magnets in foundries, junk yards, steel plants and miscellaneous industries. The constructional features of these magnets are described in detail.

SKIP HOISTS.—The 24-page brochure issued by Stephens-Adamson Mfg. Company, Aurora, Ill., describes and illustrates typical installations of S-A skip hoists which are of the single-bucket unbalanced, single-bucket counterweight balanced, and double-bucket balanced types. These hoists are intermittent in their delivery of material from low to higher levels.

News of the Month

Effective Date of Interchange Rule 66 Extended

CIRCULAR No. D. V. 619, recently issued by the A. R. A., Mechanical Division, extended the effective date of Interchange Rule 66, making car owners responsible for periodical repacking of journal boxes, as shown in the present code of rules, from March 1, 1929, to January 1, 1930.

This extension has been granted by the General Committee at the request of a number of railroad members because they are not as yet fully prepared to meet the specifications covering reclaimed oil and waste. The Committee on Lubrication for Cars and Locomotives will, in its report this year, outline processes to meet the specifications which it is expected will clear up many questions and remove any necessity for a further extension of the effective date of this rule.

After a study of replies to a questionnaire, dated December 3, 1928, on boring or broaching of journal bearings, the Committee on Lubrication for Cars and Locomotives, at a recent meeting, decided to recommend in its report to the 1929 annual meeting, that the boring and broaching of journal bearings, which is now a mandatory provision of Paragraph 11 of the Specifications (see page 89 of the current code of Interchange Rules), be made an optional requirement.

Canadian National Decorates A Locomotive

THE CANADIAN NATIONAL, by way of experiment, has painted one of its 4-8-4 type locomotives in variegated colors, the predominating color being emerald green which has been applied to the boiler shell, tender tank, and tires. The smoke box, cab, coal hopper and feedwater heater are finished in black, while a brilliant red has been applied to the front and rear buffer beams, the wheel spokes and the rod fluting. The locomotive is used in passenger service between Montreal, Que., and Sarnia, Ont.

THE NORFOLK & WESTERN has made a general advance of five per cent in the wages of employes in the mechanical department.

THE READING has increased the wages of its shopmen four cents an hour. The machinists, etc., will receive 81 cents an hour, and painters, carpenters and certain other classes, 74 cents an hour.

Clubs and Associations

THE ANNUAL CONVENTION of the Purchases and Stores division of the American Railway Association has been changed from the St. Francis Hotel, San Francisco, on June 19, 20 and 21, to the Palace Hotel, San Francisco, on June 24, 25 and 26, as announced by W. J. Farrell, secretary.

The following list gives name of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York. Next meeting, April 30-May 3, 1929, at Stevens Hotel, Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Annual meeting June 25-28, 1929, at Alexandria Hotel, Los Angeles, Cal.

DIVISION V—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting, Muehlebach Hotel, Kansas City, Mo., September 10-12.

DIVISION VI—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Annual meeting June 24, 25 and 26, 1929, at the Palace Hotel, San Francisco, Cal.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago. Next meeting, September 11-14, 1929, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting Hotel Sherman, Chicago, October 22-25.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting March 11. A paper on Transportation will be read by D. Crombie, chief of transportation. Canadian National Railways. Visit from members New York Railway Club.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 7836 So. Morgan street, Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting March 11. Discussion of recommended changes in the A.R.A. Rules.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Wiegman, 720 North Twenty-third street, East St. Louis, Mo. Regular meeting first Tuesday in each month, except June, July and August, at Broadview Hotel, East St. Louis, Ill.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meetings second Friday of each month in the Pacific Electric Club building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Tuesday each month, except June, July and August, at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS AND CAR FOREMEN'S ASSOCIATION.—See Master Car Builders' and Supervisors' Assn.

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 3328 Beekman St., Cincinnati. Regular meeting second Tuesday, February, May, September and November.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meeting first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next meeting, August 20-22, 1929, Fort Shelby Hotel, Detriot.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant, Railway Exchange, 80 E. Jackson Boulevard, Chicago. 1929 Annual meeting Hotel Sherman, Chicago, May 7-10, inclusive.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3212 Delachaise street, New Orleans, La. Meetings third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Annual meeting May 21-24, 1929, Hotel Biltmore, Atlanta, Ga.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago, Chicago.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting March 12. Paper on Oxygen The Wonder Worker will be presented, with moving pictures, by G. E. Harcke, Air Reduction Co. Annual meeting. Election of officers.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St,. New York. Next meeting March 15. A paper on Tie Tamping and Track Maintenance, with film picture illustrations, will be presented. Ingersoll-Rand night.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Tuesday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—See Master Car Builders' and Supervisors' Association.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting third Thursday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, M. P. O. Drawer 24, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205 Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SOUTHWEST MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Master Car Builders' & Supervisors' Association.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

Walter S. Campbell, railroad sales representative, eastern district of Joseph T. Ryerson & Son, Inc., has resigned to enter another field of business.

R. L. Belknap has been appointed sales manager, central region, for the Gold Car Heating & Lighting Company with headquarters at Chicago. He previously served with the Locomotive Firebox Company and the Standard Stoker Company.

F. W. Anderson, vice-president and general manager of the Northwestern Motor Company, Eau Claire, Wis., has been elected president and general manager to succeed R. R. Rosholt, president, who has been elected chairman of the board.

R. H. Gwaltney has been appointed sales vice-president of The Gould Coupler Company, with headquarters at New York. Mr. Gwaltney was also elected a director of the company to take the place of George L. L. Davis, resigned.

Matthew Griswold, who retired as manager of the Erie, Pa., works of the General Electric Company on January 1 of this year because of ill health, died at his home in Erie on February 10.

E. S. Fickes of Pittsburgh, Pa., vice-president in charge of engineering of the Aluminum Company of America, was elected a director of the company at a recent meeting of the board and W. C. Neilson, of Philadelphia, in charge of the bauxite interests of the company, was elected a vice-president.

Frederick L. Sivyer, president of the Sivyer Steel Casting Company, Milwaukee, Wis., and president of the Northwestern Malleable Iron Company, Milwaukee, died on January 22 in Milwaukee, following injuries received in an automobile accident.

The American Steel Foundries is now operating the Galesburg Malleable Castings Company, Galesburg, Ill., which it purchased several years ago, and which it has been operating as an independent company. It will be known as the Galesburg works of the American Steel Foundries.

O. M. Hullinger, sales engineer of the Ohio Brass Company, Mansfield, Ohio, with headquarters at Chicago, has been promoted to district sales manager in charge of steam road and electrification sales with the same headquarters, to succeed F. E. Johnson, deceased.

L. B. Morehead, formerly engaged in the engineering department of the Bettendorf Company, Bettendorf. Iowa, has been appointed chief engineer of the Davenport Locomotive & Manufacturing Corporation, with headquarters at Davenport, Iowa.

Samuel Higgins has retired as a director of the Vapor Car Heating Company, Inc., Chicago, and R. P Cooley has been elected in his place. The position of vice-president formerly occupied by Mr. Higgins has been abolished. Mr. Higgins will continue to have an office with the Vapor Car Heating Company, Inc., 9 Park Place, New York City.

F. E. Johnson, who retired on January 1 as district sales manager in charge of railroad sales of the Ohio Brass Company with headquarters at Chicago, died on January 15 as a result of acute dilation of the heart. He had been associated with this company for over 20 years, first in Denver and later in the Chicago territory.

William J. Corbett has resigned as secretary-manager of the Steel Founders' Society of America to become assistant to the president of the Fort Pitt Steel Casting Company, McKeesport, Pa. Mr. Corbett was graduated from Carnegie Institute of Technology in 1914 with the degree of bachelor of science in mining engineering, and later received the degree of metallurgical engineer.

Samuel Wylie Miller, consulting engineer of the Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y., and well known as a pioneer in oxy-acetylene welding and an authority on its application, died on February 3, at his home in Hollis, Long Island, at the age of 62. Mr. Miller was a native of New York and received his degree in mechanical engineering from Stevens Institute in 1887. He served as a master mechanic for the Pennsylvania at Logansport, Ind., Indianapolis, and Columbus, Ohio, and following this was with the American Locomotive Company at Dunkirk, N. Y., and Providence, R. I., after which he founded the Rochester Welding Works at Rochester, N. Y. During the war he served on the Welding Committee of the Emergency Fleet Corporation. In 1921 Mr. Miller joined the newly formed Union Carbide & Carbon Research Laboratories, Inc. He was a past president of the American Welding Society and an active member of many engineering and scientific societies both here and abroad. Mr. Miller was the donor of the Miller Medal awarded annually by the American Welding Society for work of conspicuous merit in advancing the art and science of welding. His important contributions to welding were many. He is credited with having been among the first members of this profession to visualize the possibilities of oxy-acetylene welding. He wrote several books on the subject and delivered many lectures on welding at engineering meetings.

Samuel Wylie Miller

The Prest-O-Lite Company, Inc., New York, has acquired the business of the Acetylene Products Company which operated two acetylene producing plants located respectively at Phoenix, Ariz., and El Paso, Texas. These plants are now being operated as units of the Prest-O-Lite Company. Everett R. Kirkland is superintendent of the Phoenix plant, and Carl F. Chesak is superintendent of the El Paso plant. R. G. Daggett, with headquarters at the San Francisco office, is district superintendent.

A Plan of shop practice consulting service has been inaugurated by the Malleable Iron Research Institute, Union Trust building, Cleveland, Ohio, and J. B. Deisher, of Rochester, N. Y., a specialist in malleable iron practice, has been engaged as a shop practice engineer for the conduct of the work. The general scope of his services will embrace consultation and advice upon all phases of melting furnace and annealing-oven practices and of molding practices including the gating and feeding of castings to insure soundness. Sectional shop practice meetings of shop men will also be held under the direction of Mr. Deisher. The Malleable Iron Research Institute has for many years conducted laboratory and extensive metallurgical research work under the direction of its consulting engineer, Prof. Enrique Touceda, of Albany, New York.

GEORGE H. WEILER has been appointed secretary-manager of the Forging Manufacturers Association, with headquarters at the Grand Central Terminal, New York City. This association embraces the major manufacturers of heavy forgings in this country. Mr. Weiler entered the service of the Brooks Locomotive Works, Dunkirk, N. Y., in 1898, and for the past 30 years has been associated with the American Locomotive Company at its New York office. He served in the accounting, engineering, manufacturing and sales departments of that company, his last position being that of manager of sales.

W. N. AGNEW, general traffic manager of the Worthington Pump & Machinery Corporation, has been appointed assistant to the president and general traffic manager with headquarters at New York. Mr. Agnew has been connected with the Worthington organization for more than 25 years. He joined the staff of the old International Steam Pump Company, as traffic manager, in 1910, and in 1925 was made general traffic manager of the Worthington Pump & Machinery Corporation.


W. N. Agnew

THE TRIMONT MFG. COMPANY, Roxbury, Boston, Mass., has purchased the Stillson wrench business of the Moore Drop Forging Company, of Springfield, Mass. The manufacture of both the Original Pattern and Popular type Stillson wrenches will be continued as the Sando Original Pattern Stillson and the Moroco Popular types, respectively.

ROSS F. HAYES, who during the past five years has been engaged as manufacturer's agent, railroad supplies at New York, has become connected with the Adams & Westlake Company as representative, in charge of eastern sales of Rex car specialties. Mr. Hayes was formerly for many years with the Curtain Supply Company as eastern manager at New York and later as general sales manager Chicago. The Curtain Supply Company was consolidated about two years ago with the Adams & Westlake Company. Mr. Hayes is located at Adams & Westlake New York office.

THE INDUSTRIAL TRUCK ASSOCIATION has been formed, the membership list being composed of manufacturers of electric industrial trucks, tractors, storage batteries and accessory equipment. The association is a development of the co-operative sales promotion activity which these manufacturers have conducted for the past three years through the Society for Electric Development, Inc. The new association headquarters are located at 52 Vanderbilt avenue, New York City. C. B. Crockett has been retained as secretary in charge of the staff operations. Supported by an initial membership of 14 companies producing over 90 per cent of the products of the industry, the Industrial Truck Association has for its purpose the broadening of present markets, education of the public and the solution of materials handling problems by the use of mechanical equipment. The founders of the association also see in this co-operative effort, an opportunity for further simplification and standardization of their product and a free exchange of statistical information which characterizes the successful businesses of today. The officers of the new association form its board of directors. They are as follows: President, M. S. Towson, president of the Elwell-Parker Electric Company; vice-president, E. J. Bartlett, president of the Baker-Raulang Company; vice president, W. C. Allen, president of the Yale & Towne Manufacturing Co.; treasurer G. A. Freeman, president of the Automatic Transportation Company.

Personal Mention

General

R. G. MCANDREW has been appointed mechanical engineer of the New York, Ontario & Western, with headquarters at Middletown, N. Y., succeeding W. H. Davis retired.

J. T. FITE, general foreman in the car department of the St. Louis-San Francisco, at Springfield, Mo., has been promoted to mechanical inspector of the system, with headquarters at the same point. Mr. Fite succeeds John Foster, retired.

GEORGE CROWDER, general foreman of the mechanical department of the Georgia & Florida, has been appointed superintendent of motive power, with headquarters at Douglas, Ga., succeeding W. H. Dyer, deceased.

F. N. HIBBITS, superintendent of motive power of the Lehigh Valley, with headquarters at Bethlehem, Pa., having voluntarily resigned from that position, has been appointed consulting superintendent of the department.

D. W. Davis, master mechanic of the Wyoming division of the Lehigh Valley, with headquarters at Wilkes-Barre, Pa., has been appointed superintendent of the Sayre shops. Mr. Davis will also assume the duties of master mechanic of the Seneca and Auburn divisions.

JOHN FORSTER, mechanical inspector of the St. Louis-San Francisco at Springfield, Mo., retired from active service on January 1. From 1898 to 1900 Mr. Forster was superintendent of motive power of the Colorado & Southern at Denver, Colo., and from 1902 to 1924 he was master mechanic on the Frisco at Kansas City, Mo.

M. C. HABER, engineer of road tests of the Union Pacific unit; C. W. Smith, inspector of shop standards; A. J. Harner, lubrication engineer, and J. K. Peters, assistant to the mechanical engineer, have been appointed to corresponding positions on the system, with headquarters at Omaha, Neb. In the February *Railway Mechanical Engineer* it was incorrectly stated that these men had been appointed special representatives of the general superintendent of motive power and machinery.

Master Mechanics and Road Foremen

M. R. Brockman, master mechanic of the Southern at Bristol, Va., succeeds H. G. Stubbs as master mechanic at Macon Ga.

W. G. MCPHERSON has been promoted to district master mechanic of the Algoma district of the Canadian Pacific, with headquarters at North Bay, Ont.

W. R. SEDERQUEST has been appointed master mechanic of the Midland division of the New York, New Haven & Hartford, with headquarters at Boston, Mass., succeeding D. P. Carey.

G. H. NOEWOLL, division master mechanic of the Lethbridge division of the Canadian Pacific at Lethbridge, Alta., has been transferred to the Regina division with headquarters at Regina, Sask.

C. J. HENRY, assistant master mechanic on the Eastern division of the Pennsylvania at Canton, Ohio, has been transferred to the Wheeling division at Mingo Junction, Ohio, succeeding J. S. Richards.

M. JEFFERSON, master mechanic of the Lehigh Valley at Sayre, Pa., has been appointed master mechanic of the Wyoming division.

J. S. RICHARDS has been appointed master mechanic of the Erie and Ashtabula division of the Pennsylvania, with headquarters at Mahoningtown, Pa.

H. G. STUBBS, master mechanic of the Southern, with headquarters at Macon, Ga., has been transferred in the same capacity to Princeton, Ind., succeeding Frank Johnson resigned.

G. F. TIPTON, shop superintendent of the Southern with headquarters at Knoxville, Tenn., has been appointed master mechanic, with headquarters at Bristol, Va., succeeding M. R. Brockman, transferred.

A. PEERS, district master mechanic of the Saskatchewan district of the Canadian Pacific at Moose Jaw, Sask., has been transferred to the British Columbia district, with headquarters at Vancouver, B. C.

H. M. SMITH, division master mechanic of the London division of the Canadian Pacific at London, Ont., has been transferred to the Schreiber division, with headquarters at Schreiber, Ont.

F. D. WARNER, general locomotive foreman of the Canadian Pacific at Moose Jaw, has been promoted to division master mechanic of the Moose Jaw division, with headquarters at the same point, succeeding W. G. McPherson.

J. B. PORTER has been appointed master mechanic of the Old Colony division of the New York, New Haven & Hartford, with headquarters at Taunton, Mass., succeeding W. R. Sederquest.

E. J. LEMIEUX, division master mechanic of the Regina division of the Canadian Pacific at Regina, Sask., has been transferred to the Lethbridge division, with headquarters at Lethbridge, Alta., succeeding G. H. Noewoll.

ISAAC PEREZ, who served as master mechanic at various points on the National of Mexico since 1916, has been appointed master mechanic, with headquarters at Matias Romero, Oax., succeeding Jose Morales Sanchez, who has been transferred to Cardenas, S. L. P.

Shop and Enginehouse

D. P. CAREY, master mechanic of the Midland division of the New York, New Haven & Hartford, has been appointed superintendent of shops, with headquarters at Readville, Mass.

J. P. LAUX, superintendent of the Sayre shops of the Lehigh Valley, has been promoted to superintendent of motive power, succeeding F. N. Hibbits.

W. C. SEALY, acting superintendent of shops on the Canadian National at Stratford, Ont., has been promoted to superintendent of shops, with headquarters at the same point, succeeding G. M. Wilson, who retired from active service.

A SCHOOL with a three-year course for brakemen, firemen and shopmen has been established by the Colorado board of vocational education at Grand Junction, Colo. The school is housed in a specially built car on the Denver & Rio Grande Western and has an enrollment of 250.

LANDIS MACHINES.—Landis bolt threading machines, staybolt threading machines, bolt factory threading machines, and automatic forming and threading machines are described in detail in catalogue No. 32 issued by the Landis Machine Company, Waynesboro, Pa. Data regarding various types of bolt threading die heads and the Landis chaser are also contained in the catalogue.

Car Department

FRED A. ISAACSON, acting engineer of car construction of the Atchison, Topeka & Santa Fe, has been promoted to engineer of car construction, with headquarters at Chicago. Mr. Isaacson has been connected with the Santa Fe for 24 years. He was born at Topeka, Kan., on November 12, 1884, and after completing two years of high school, he became a machinist apprentice in the car shops of the Santa Fe at that point in 1900. He left railway service in 1905 to engage in other business, during that time completing courses in mechanical and electrical engineering. In January 1910 Mr. Isaacson re-entered the service of the Santa Fe as a draftsman on signal construction in the office of the signal engineer at Topeka, being transferred to the office of the mechanical engineer in the following year. He was later advanced to pattern recorder and in October, 1914, was promoted to chief locomotive draftsman. In January, 1922, he was further promoted to assistant mechanical engineer, with headquarters at Topeka, where he remained until April, 1928, when he was transferred to Chicago, in charge of inspection on new passenger and freight cars, motor inspection cars and locomotive tenders. On July 1 Mr. Isaacson was appointed acting engineer of car construction.

Fred A. Isaacson

Purchases and Stores

DAVID E. REYNOLDS has been appointed purchasing agent of the Bessemer & Lake Erie and the Union Railroad Company, with headquarters at Pittsburgh, Pa.

N. H. FOSTER, purchasing agent of the Los Angeles & Salt Lake, with headquarters at Los Angeles, Cal., retired from active duty on December 31 after nearly 50 years of railway service.

GEORGE W. LEIGH, assistant purchasing agent and general storekeeper of the Minneapolis, St. Paul & Sault Ste. Marie, the Duluth, South Shore & Atlantic and the Mineral Range, has been promoted to purchasing agent of those companies, with headquarters as before at Minneapolis, Minn., succeeding Edward T. Stone, deceased.

JESSE B. NOYES has been promoted to general storekeeper of the Minneapolis, St. Paul & Sault Ste. Marie; the Duluth, South Shore & Atlantic and the Mineral Range, with headquarters at Minneapolis, Minn. Mr. Noyes has been connected with the former railway and the Wisconsin Central for more than 29 years. He was born on December 13, 1877, at Baraboo, Wis., and entered railway service as a clerk on the Wisconsin Central on December 16, 1899. During the following 10 years he was advanced through the positions of traveling storekeeper and local storekeeper and when the Wisconsin Central was leased by the Soo line on May 1, 1910, he became division storekeeper on the latter road at Fond du Lac, Wis. On the May 1, 1920, he was transferred to Minneapolis. His promotion to general storekeeper of the three railways became effective on January 1.